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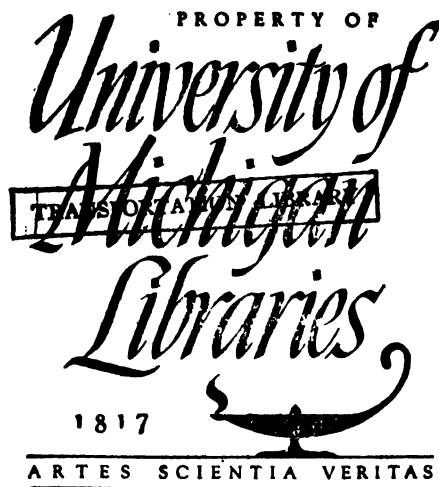
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REPORT
OF THE
PROVINCIAL INSTRUCTOR IN ROAD-MAKING
ONTARIO.
1897.



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REPORT

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PROVINCIAL INSTRUCTOR IN ROAD-MAKING

ONTARIO

1897.

(PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE.)

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REPORT
OF THE
PROVINCIAL INSTRUCTOR IN ROAD-MAKING,

1897.

*To the Honorable JOHN DRYDEN,
Minister of Agriculture.*

SIR,—I herewith beg to submit to you my report for the year 1897, on Road and Street Improvement in Ontario. It is gratifying to record the increasing interest which is being taken in this branch of public work, and to observe the efforts in many districts and in many ways, to bring about reform. A large number of municipalities were visited by me during the year, addresses delivered and reports made (as outlined in my report of 1896), the requests for my services in this respect being very numerous, so numerous, I regret, that it was impossible to comply with all. The fullest information appears to be everywhere desired, and any means suggested for bettering the condition of the common highways, is given the most earnest consideration.

I have the honor to be,

Sir,

Your obedient servant,

A. W. CAMPBELL,
Provincial Instructor in Road-making.

PARLIAMENT BUILDINGS,
TORONTO, Ontario, 10th January, 1898.

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REPORT

OF THE

Provincial Instructor in Road-Making.

GOOD ROADS—A NATIONAL PROBLEM.

The demand for increased transportation facilities, for more rapid transit, for better and shorter routes is arising from all quarters, is far reaching and urgent. In response to this, railways are improving the character of their roadbeds and rolling stock. Canals are being deepened and widened, and harbors improved. Vessels of greater capacity and speed are being constructed. Cold storage is being provided. In the cities electric street railway systems have displaced the slower horse cars, and are stretching their tendrils along the country highways; the bicycle has obtained a prominent place in the transaction of business; motor carriages may be seen on the streets of the larger cities, and present indications are that they will soon become an important means of travel and transportation. Nations are growing greater and stronger, and trade is forcing its way more rapidly and with greater volume along the veins and arteries of commerce.

Addressing the Board of Trade of Toronto, the chief commercial city of Ontario, the Premier of the Dominion recently said: "Let us cheapen the cost of transportation, and from that moment we have in the markets of Great Britain a preference for the products of Canada." Referring more directly to the importance of the common highway and its relation to trade, the Premier of New Brunswick, the Hon. H. R. Emerson, in an address at a banquet recently tendered him in the city of St. John said: "I have already given you assurance on behalf of my Department that the good roads movement will be furthered and encouraged as far as in our power lies. The betterment of our public highways which are avenues of transportation and form an essential part of the great system which is necessary to transfer the products of our farms from the farm granaries to the busy markets of the old land, is a most desirable end to be attained, from the standpoint of economics, as well as from social or other standpoints."

The question of road improvement has been too much regarded as a matter of individual loss or gain. It is necessary to convince farmer Jones that he is losing yearly by bad roads \$50, Brown that he is losing \$75, Smith that he is losing \$100. This is the phase which the good roads advocate most frequently has to meet. Seldom is the problem regarded in the broad light of its influence upon national prosperity. The total production of Ontario farms has a value annually, it is estimated, of \$200,000,000. All this must first pass over the common highways before reaching the markets. It is the basis of Ontario's wealth. The amount is far in excess of that needed for home consumption and the only resource is to obtain a market in foreign countries. This market is available only so far as we can sell more cheaply, and produce a better quality than other

competing countries. It is not the effect on present conditions which constitutes the evil of bad roads ; but it is in the conditions which they prevent that the loss lies. It is not on the principle that it is so expensive to draw one load of produce to market, but in the principle that, with every means provided for easy, quick and good transportation, a market would be created for two loads. Many links in the system of transportation are being perfected, but the chain will not be complete without cheap transportation over the first part of the journey, the common country highways.

GOOD ROADS AND AGRICULTURE.

Good roads will be of vast benefit to agriculture. They increase the profits of the farm by decreasing the cost and difficulty of transportation. It is cheaper to draw produce to market in one load than in two ; on the same principle that it is cheaper that one team and a driver to do the work of two teams and two drivers. Good roads will increase the opportunities of farming and extend the range of marketable produce. Fruit and other perishable articles can be marketed in better condition, and a purchaser will be obtained for produce which now cannot be taken to market because of the difficulty of transporting it from the farm to the city or railway station.

A market in England is awaiting all kinds of Canadian fruit as soon as the difficulty of carriage is overcome and the fruit offered for sale in sound condition. Rapid transit on steamship and railway, with cold storage, is being provided, but until the fruit can be taken from the farm to the railway in the best possible condition ; that is, with the greatest speed and least amount of jolting, we must labor at a serious disadvantage. With cheese, the constant complaint is that the quality of the Canadian product is not what it should be. Cheesemakers are all aware that the quality of the cheese is injured by churning the milk over rough roads ; and that a more uniform quality can be obtained by making the cheese in large factories, a condition which can only be brought about by making the roads such that the milk can be carried greater distances.

The dulness and isolation of farm life will be overcome by good roads, and they will thereby tend to elevate and bring about a better citizenship. The school, the church, the public meeting, the neighbor's house will be more easily reached. The effect of all this, the increased land value, the greater profits and pleasures of the farm, is to render the country attractive rather than repellant. The effect is to draw the people of the city to the country rather than drive the people of the country to the city. "How can we relieve the congested condition of our cities ?" "How can we keep our boy on the farm ?" are questions demanding an early solution. By making the farm profitable, by giving to energy and ambition sufficient business opportunities on the farm, these problems will be solved, and one of the most important factors in the solution is "Good Roads."

GOOD ROADS AND COMMERCE.

Good roads are of great benefit commercially. Agriculture is the foundation of the wealth of this country. As agriculture prospers so will business prosper. Better home markets and better foreign markets for the farmer will bring more money into the country. This means increased sales for the merchant and a greater demand on the manufacturer. Bad roads, beside the retarding influence on the country by lessening its ability to compete in foreign markets, cause produce to be marketed, not as prices or the demand require, but as the roads permit. The result is that the market is alternately glutted or starved ; there is either unnatural excitement or depression. The stores are either deserted or extra clerks have to be employed. Railways either cannot provide cars to move the contents of the granaries, or else their cars and their crews are in idleness. Such fluctuations cannot but be hurtful.

When farmers can market their produce easily and regularly they have money with which to enable the merchant to turn over his stock and meet his obligations at the bank. The banks are thereby enabled to do business to greater advantage, and the whole

machinery of commerce moves with less friction, less useless expenditure of energy. The stringency which so often takes place in the fall as a result of bad roads; the bad roads of Christmas time which so often bring disappointment to the merchant; the resulting failures which act and react on all classes of society are all of too frequent occurrence.

ONTARIO ROADS.

It is doubtful if there is a mile of true macadam road in Ontario, outside of a few towns and cities. There are miles of road which are covered with dirty gravel or rough, broken stone, and are popularly supposed to be macadamized, but they more resemble the roads Macadam found in England three-quarters of a century ago, the kind he removed, rather than those he constructed.

A century ago the roads of Ontario, such as existed, and they were very few, were mere trails. To-day, notwithstanding the amount of money and labor placed on them, the majority are little better than trails. This criticism may seem overdrawn to those who drive over some of the best gravel roads during the summer season; but if the journey had been made in the fall or spring, the rainy seasons, its fairness would become more apparent.

While the majority of highways in Canada are strikingly like the trails from which they have sprung, nevertheless we have highways which are of surpassing magnificence. The Canadian Pacific Railway spanning the continent is, in extent, daring and durability of construction, unequalled in the world. The populous districts of Canada are covered with networks of steel; while other lines are being projected wherever opportunity presents itself. But while capital has exhibited so much enterprise in providing the great lines of commerce, the lesser routes have been overlooked and neglected. Common highways, while less in extent and cost, are not one whit less in importance. Over them must first pass all the freight which feeds the greater railways, and it is this first cost of transportation which so enormously increases the cost of production, and lessens our ability to compete in the markets of the world. The improvement of country highways is an investment, not a tax, and will be a most profitable one, commercially and socially.

From the middle of October until the end of December, and from the first of March to the middle of May, a period of five months, by far the greatest part of the mileage of the Province is mud, ruts and pitch holes. This may vary somewhat at the more northerly and more southerly parts of the Province, but it is the general rule of the average year. Of this period of five months there are at least two months of the year when the roads are practically impassable for loads. From the middle of November until the middle of December; from the middle of March until the middle of April, the agricultural trade of the country is practically cut off. For the remaining three months of the five the roads are barely passable. To this may be added January and February, for part of the Province, those southerly counties of Western Ontario where sleighing exists for two or three weeks at the most. If we include a winter month (and during the winter there are many days when travel is shut off), there are six months of the year when travel and teaming in Ontario is retarded by bad roads. Part of that time, at least two months, as pointed out, country traffic is practically impossible. If during those two months fortune favors us with a few days when teaming can be done, there are plenty of days during the remainder of the year to make two months of impassable roads over the Province generally.

AN ESTIMATE.

It is difficult to fully estimate what this means to each farmer individually, as it affects the value of his farm, the marketing of his produce, his business affairs, social intercourse of himself and family with his neighbors, attendance at church, at public meetings, the attendance of the children at school, and numerous other similar matters.

Horses are standing idle in the barn eating hay and oats when they would otherwise be at work earning their food as well as eating it. The idleness of horses means in the great majority of cases idleness of the teamster.

In order to forestall the bad roads the farmer goes about his business, does his teaming and marketing while roads are good in the early fall. His plowing is left until the roads are bad, but when the roads are bad the ground is soaked and unfit for cultivation. It is on clay land where the roads are generally the worst; in such districts it is generally found that marketing and cultivation come in the order described, and it is clay soil which is most injured by being worked when saturated with moisture. It cannot be argued that these matters are of no consequence. Many individual farmers may be willing to put up with all these drawbacks. But when aggregated, the loss is one which the country as a whole cannot afford.

The statistics compiled in the Bureau of Industries show that in 1896 there were in Ontario 434,384 working horses owned by the farmers of Ontario. This number does not include the unbroken horses nor breeding mares, but represents the number actually used for work. Let us assume, and the assumption is a very moderate one indeed, that one-half of these horses, which would otherwise work, are prevented from doing so for two months or sixty days of the year, and that their teamsters are also left in idleness. This means that for sixty days 108,596 teams and 108,596 teamsters are idle. The price paid generally is \$3 per day for a team with a driver, and is a proper estimate of the value to the country. The direct financial loss daily, therefore, is at least \$325,788, and for sixty days, \$19,547,280—no inconsiderable tax for one Province with a population of about two million. At three per cent. this is the interest on a capital of \$651,576,000.

There is nothing in this of the annual loss through the interference with trade. There is nothing of the loss of time, there is nothing of the smaller loads which have to be drawn at all seasons of the year because of merely rough roads. There is nothing of the increase in land values that would result through good roads. There are many thousand of acres in Ontario which are remote from the market towns and with only common dirt roads over which the market can be reached. These isolated farms are of very little value, worth not one-half nor one-quarter what they will be when first-class roads are provided. Instances are not lacking to show that property in the immediate vicinity of even a city market has increased fifty per cent. by the construction of good roads. When we consider that very few roads in even the oldest and best settled districts are what they should be, and that many are decidedly what they should not be, it is apparent that the increase in land values throughout the Province by a complete system of roads would be very great.

THE OBJECTS OF REFORM.

The means whereby the roads of Ontario have been brought to their present state have been wasteful in the extreme. There has undoubtedly been earnest effort and honest motive on the part of many. But in the absence of systematic management little could be expected. Statute labor has been assessed, the nominal value of which is one dollar per day. It is safe to say that the average day of statute labor as actually performed is not worth fifty cents. Even if honest work had been given, it has been applied in a manner so disconnected and with so little knowledge of the true principles of road-making, that economical results could not be anticipated. To bring order out of chaos is the work of the road reformer. If we are to have good roads in the country, it is only by building them in a business-like way, on business principles.

The general system of roads required by the Province is not of an expensive kind. Gravel roads, or in the absence of gravel, broken stone roads, built cheaply but well, are needed. They should be built in such a way as to suit the traffic over them. Roads which are either insufficiently strong, or which are stronger than necessary, are each of them wasteful. There is no immediate likelihood of roads of the latter kind being built. The great defect which now characterizes them is that they are not strong enough, are of

the kind which "break up." Roads should be constructed and kept in such a state of repair that they will not "break up." Roads which are rutted, cut up and converted into a canal of mud for any part of the year, in that time are injured to such an extent that the labor placed on them is largely thrown away. The "breaking up" process forces the stone down into the mud, mixes the mud with the stone, and takes away the durability of the road. The gravel and broken stone should be placed on the roadway and so maintained that at all times it will form a smooth, hard crust. To provide roads for the light and moderate traffic which passes over the generality of our country highways, and to do so in the most economical manner, there is need of the most skilful application of the principles of road-making as to choice and preparation of materials; drainage; the use of proper implements; re-locating the road in some instances so as to best avoid steep grades, cuts, fills and bad ground; grading, crowning, etc. All this, and much more, is now left unreservedly to the pathmaster. Until good business ability, system, and a knowledge of road-making are combined there cannot be good roads in this Province.

How to place before the people of this Province roads which will educate, roads which will by their merit compel their extension widely and within a reasonable period, is a problem deserving of an early solution. Only those who have been active in promoting the cause of good roads can appreciate the difficulty. While there is a demand for good roads by the general public, there is still a prejudice existing in favor of old systems and old methods which it is difficult to counteract by ordinary measures. The good roads movement in Ontario has reached the stage where a united effort of the foremost citizens should be made. What is needed is that there should be measures taken to improve in a large way the main roads of the Province. Whether this should be done by each township municipality, or whether a county, or even a provincial road system should be adopted to attain this end, are questions which are to be considered.

Township systems are in force throughout the greater portion of the Province, and the result we have with us. Hastings is the only county which has a well developed county system, and the means employed there have a decidedly beneficial effect on the roads. Wherever roads, however, have been brought to the highest excellence, as in France, England or Germany, and wherever on this continent the good roads movement has reached its most successful stage, as in Vermont, New Jersey, Connecticut or Massachusetts, state aid has been given to greater or less extent.

One mile of good road will secure more converts to the cause of improved roads than will ten miles of bad roads. The people of this country have for years been driving over bad roads. They know what bad roads are, but do not know what good roads are. A few years ago town streets which could boast of coal oil lamps possessed a luxury, and we were contented for we knew nothing of gas. When gas replaced the kerosene it was pronounced a marvel. To-day so far are we from returning to the dim light of coal oil that electricity is not brilliant enough. When the people see them, experience them, feel and know the benefits of good roads, there will be no possibility of a return to the mud and ruts that now prevail.

The object of the good roads movement must be attained by a process of education. Good roads are their own best advocates. That is wherein the strength of the road reform movement lies. One step in advance is never lost, but lends impetus for the next. A single example of a good road will argue more for the cause of road improvement than will a volume of words. A good road must be seen to be fully appreciated. The benefits cannot be stated in dollars and cents, but have to be experienced in order to be realized.

STATUTE LABOR.

The great majority of roads in Canada are under the control of township councils, and are built by statute labor supplemented by money grants. The statute labor system is suited to a pioneer age. It suits the abilities of the people making a home in a new country, and it suits the spirit of their circumstances. They feel keenly the need of improving their roads, and work with a will earnestly and faithfully. That was the history of statute labor in the pioneer days of what are now the populous districts of Canada. But where the townships have grown wealthy and well populated, a different condition exists. To such an extent has statute labor degenerated that some townships find that they can do more work by commuting all the labor at thirty-five cents per day.

If statute labor has not outgrown its usefulness, there is certainly need for reform when a man's labor is worth less than thirty-five cents a day. A feeling in favor of statute labor still holds in some localities but is growing weaker. There is not a country in the world, characterized by good roads, where a system of statute labor is in use. To a slight, but very slight extent, it may be said to be used in France, but with very different methods of applying it. If it is to be retained in Ontario, the present feeling of the people strongly indicates that it will have to be placed on a basis whereby satisfactory results can be obtained.

There is a prevalent opinion that a resident on a concession road knows better than anyone else the requirements of that particular road. A remarkable feature, however, is that no two citizens agree in their ideas of what work should be done, or how it should be done. No doubt there are cases in which one man is right, but when one man is right all the rest must be wrong. Pathmasters are appointed in turn from among these to plan and superintend the roadwork. The only result which could reasonably follow from such a system is that which we find—waste and bad roads.

The result of this lack of supervision is mismanagement in actual road construction. A description of the actual work done sounds like ridicule, however earnest it may be. A statute labor day is short, of eight hours, but the men are rarely on the ground for more than six hours. A good part of the six hours is spent in gossip, in arguing as to what should be done, and in finding fault with what is being done. Another part is spent in looking up scrapers and plows that should have been provided before the work was commenced. When we consider the class of teams sent out by the rate-payers, the wagons which can carry only half a load, the boys who come to do a man's work, these and many other details, the friends of statute labor must necessarily frame numerous apologies.

Statute labor is performed at a time of year when every farmer can use his time to good advantage on his own land, but instead of remaining where he can do the most profitable work he uses his time in paying a road tax. A large part of the time spent in road work is unquestionably wasted. In addition a considerable part of our annual tax is also expended on the roads. A careful consideration of this expenditure will show that many of the leading roads, far from being good, cost much more than first-class roads should cost. Nor is this all; the most regrettable feature is that through improper plans and imperfect construction the most expensive form of maintenance has been imposed.

WASTE OF MONEY.

Councils commonly appropriate an amount of money each year to be spent on the roads. If this money were spent in making complete and durable work it would be of the greatest assistance in improving the roads. We find, however, that the money is distributed in small sums among the pathmasters, is spent in small sums for repairing temporary culverts: in doing a little draining in front of the farm of some discontented ratepayer to appease him; in doing no particular work at all, but merely to give some voter an opportunity to earn a few dollars. In such ways as these is the money which should be spent on durable improvements, scattered, wasted and misapplied.

IMPROVING PRESENT CONDITION.

If a supervisor were appointed, if pathmasters, (and fewer of them) were appointed for a term of years to carry out the directions of the supervisor, and if to these positions the right men were appointed, a considerable step would be taken towards the better management of roads in the townships. Under systematic management, money and labor could be made to work together to the best possible advantage. At present each pathmaster is given a few dollars and a few days of labor. He is surrounded by neighbors. Nothing but patchwork can be expected. By consolidating this money and labor; by using the statute labor in the ways in which it can be turned to the best advantage; by using the money in purchasing material and doing work to which statute labor is not adapted; by seeing that all this work is properly done, and at the right time, much would be done to improve present conditions.

UTILIZING STATUTE LABOR.

One of the most profitable methods of using statute labor is to utilize it in hauling gravel. In this work there is less opportunity for wasting time; it is work which is more agreeable than much of the other work of grading and ditching; it is work which the average farmer understands to be of direct benefit and is entered into heartily.

It follows that it is better for other means to be used in performing other work. For the grading of the roads there is machinery which every township should possess. For the operation of these machines one man should be hired, as skill and experience are absolutely necessary. It cannot be passed around from farmer to farmer like a scraper or a plow. These machines do not know how a road should be shaped, but in the hands of a man who does, they are exceedingly valuable. For draining and ditching it is usually best to hire the work done by men who are accustomed to this class of work. One of the most necessary steps to be taken so as to receive the greatest benefit from statute labor is to see that the material, whether gravel or broken stone, is prepared in the pit or quarry, ready to be drawn to the road. If screening, crushing or stripping a pit is necessary, it should be done before statute labor commences. Gravel may be plentiful, but of a very inferior quality. Usually no effort is made by the council to screen the gravel, remove the surface soil from the pit or in any way prepare the gravel for being placed on the road. Teamsters go to the pit, one or two at a time; it is of inferior quality, but they cannot undertake the task of removing the earth and clay, in order to satisfy their few days of labor. In other sections there is no gravel, but field and quarry stone is to be found in abundance, frequently along the road to be improved. But with this material unprepared for road work, nothing can be done by the farmers except to plow and scrape the mud, and in other ways put in their time in useless effort. If the council would purchase or otherwise employ a rock crusher to prepare this stone and leave it ready for hauling, if they were to purchase screens, strip pits, etc., and see that nothing but first-class gravel was provided, farmers would be encouraged and would willingly spend their time to the fullest extent in hauling this material.

A SUPERVISOR.

The first and greatest need of every and any system of road construction, is to have one man at the head of the work to act as a general supervisor. He must be a practical man, and if possible, experienced in road construction, and acquainted with the principles underlying it. The advantage of having such an officer, appointed by by-law, with term of office as secure as that of a township clerk, will be best explained by stating his duties:

- 1st. The supervisor should prepare a plan of his district, or township, showing all roads, and the location on them of all culverts, bridges and water courses, classifying roads according to their requirements.

2nd. He should prepare a list of all culverts and bridges, showing dimensions, material used in construction, their condition and the direction of the watercourses passing through them, with memoranda as to the course of the water and location of the outlet.

3rd. The plans and records should show, as to roads, whether they are of gravel, stone or earth, graded or ungraded, the system of drainage, and nature and extent of traffic upon them. He should carefully study the present and future requirements of traffic on all roads, the class of roads best suited to such traffic, the width and depth of metal, width of graded portion, amount of crown and other details of construction.

4th. He should possess full information as to location, extent and quality of material suitable for road construction, and amount of plank and timber obtainable from ratepayers in the township or district, suitable for repairs.

5th. He should report to the council as early as possible in each year, showing the number and location of culverts and small bridges to be re built or repaired. with a detailed statement of all material required for this work, and an estimate of the cost. It would also be advantageous to have a probable estimate of material required during the following year, presented each fall so that, if thought advisable, it may be purchased and delivered on the ground during winter months or other most convenient season, and in this way utilize as much as possible the labor of ratepayers during the slack season.

6th. His report should specify the condition of all bridges, indicating those which require repairs or reconstruction, together with an estimate of cost, and a statement dealing with such special protection work on streams as he may deem worth the council's consideration. There should also be reference to any needed re-location or deviation of existing roads with a view to doing away with bridges, culverts, expensive grades, cuts or other features which tend to prevent permanent work and economic maintenance.

7th. He should consult with all pathmasters and report to the council, showing the number of days labor in each division, the work to be undertaken, and the amount of money which should be appropriated by the council to properly utilize the statute labor.

8th. He should arrange with divisions desiring to compound statute labor for a term of years, with a view to the construction of permanent and finished work.

9th. He should take stock annually and report to the council on all machinery and implements, showing their condition and where kept.

10th. He should carefully examine all parts of the township where gravel and stone exist, and should by borings and tests determine the quality and extent, and report thereon to the council. All material, stone, plank, gravel, etc., should be purchased by the supervisor in large quantities and under instructions from the council, the required amount to be determined by his estimates referred to above. As far as possible the material should be purchased by tender, and due consideration should be given to any ratepayer having such material for sale. When purchased it should be delivered and stored at convenient points and placed in charge of and used by the pathmaster, subject to the order of the supervisor, and in emergency work.

11th. He should prepare specifications of all work for which the council makes appropriations. Contracts should be awarded to the lowest bidder if proper security is given, but the work should be subject to the approval of the supervisor, and all accounts should be certified by him before payment.

PATHMASTERS.

There are many men in this province who are capable of taking the oversight of road construction, but the system of changing the pathmasters every one or two years is not likely to produce men who are well qualified in this respect. Appointed in the spring, the pathmaster has no time to make a study of the subject such as it demands. Nor is the fact that he will be succeeded by someone else as pathmaster the following year an encouragement to effort in this direction.

Road divisions or "beats" should be from three to five miles in length. A path-master should be a permanent officer, and his division should preferably be such that the most of his travel will lead him over the greatest portion of it. He need not receive a salary but may as a slight recompense be preferred in doing small jobs under the supervisor, where the work is not considered of sufficient importance to be let by contract. He should in addition give special attention to all emergency work, such as washouts, broken culverts and bridges. If the time required to oversee the statute labor in his division is more than would be needed for his own statute labor, he should be paid for such excess under certificate of the supervisor or council, the object being to secure proper supervision of all work performed; the council or supervisor to determine whether the excess time was actually necessary to oversee the work of the division, in accordance with the local by-law of rules and regulations, which should be framed so as to include this matter.

GRAVEL ROADS.

Gravel is very plentiful in many parts of Canada, and where it can be obtained of a good quality within reasonable hauling distance, makes a cheap but good road surface. As previously pointed out, it should be clean, containing little sand and clay, since it is the stone, not the earthy materials, which are needed on the road. Nor should large stones and boulders be mixed with it, as they will work up and roll loosely under the feet of the horses and the wheels of vehicles.

In the preparation of gravel it is frequently advisable to place a stone crusher with screen attachment in the pit. By passing all the gravel through, the sand and clay are removed and the large stones broken by the one operation. If the gravel is fit to be placed on the road without such treatment, in nearly every case it will be necessary to send a man over the road to rake off large stones and break them by hand.

Much carelessness is exercised in taking gravel out of the pit. In the pit we may find, for example, the surface layer of from two to four feet composed of earthy matter, then a layer of four or five feet of good gravel, then a stratum of coarse sand one or two feet thick, and underlying this another stratum of fairly good gravel. The common practice followed by teamsters is to scrape down the face of the pit, causing the soil, clean gravel and sand to mix together at the bottom. This is put in the wagons and taken to the road.

Very few gravel pits provide material fit in its natural state for use on the road. Screening and crushing are often necessary, particularly the former, to remove sand and clay from among the stone. It is the stone which is wanted on the road—not the sand and clay. There is enough sand and clay already on the road without drawing it several miles from the gravel pit. Dirty gravel, while it unites readily and forms a good roadway in dry weather, dissolves, turns slushy and ruts with equal readiness in wet weather, whereas with clean material the stones assume a mechanical clasp the one of the other that will not yield to the same extent in wet weather.

Earth and sand attract moisture and after a few hours rain the road becomes softened. In this slight ruts are formed which hold water, the whole structure becomes saturated, weakening the bond and permitting each successive vehicle to churn the ruts deeper until the gravel coating is cut through.

PURCHASE OF GRAVEL.

A great many townships buy gravel by the load. This is very much like buying water by the pailful instead of digging a well. Gravel should be bought by the pit or by the acre, and should be available at all times for any farmer who wants to increase the value of his land by improving the road past it. Especial care should be taken by councils to see that, prior to the performance of statute labor, the pit is stripped and the gravel otherwise treated if necessary.

This material, purchased at from five to ten cents a load, when mixed with an excessive amount of sand or clay, is a most expensive road material for much travelled highways. When we consider the number of pits in some townships and their immense size, representing that thousands of loads have been taken out, and then consider the short mileage gravelled, we must readily see that something in the quality of material and the mode of construction is radically wrong. In some instances much more than the value of a whole farm has been paid for gravel purchased by the load and taken from a small corner. If first class material were used, under ordinary traffic the annual repairs rendered necessary would be very slight.

In searching for gravel, the clearest indications are usually to be found along the banks of streams, where any extensive strata is apt to be exposed. A post-hole auger affords a convenient means of making tests over the surface of the soil for gravel, but the best implement is generally a simple form of drill. There are cases in which gravel beds may be entered at the level of a stream bed, and water is thereby obtained for washing the metal by natural drainage, affording a cheaper means of freeing it from sand and earthy matter than by screening. Gravel is still being deposited in drifts and bars by the agency of streams; this will be found to partake of the character of the pit gravel of the locality but generally will contain less clay, although sand may easily be in excess. This is usually one of the best sources, as the gravel can be washed by natural drainage. Lake gravel is often a good metal but varies greatly. It is apt to be slaty, an undesirable quality. It will be free from dirt and clay, but contains sufficient sharp sand to secure consolidation, especially if a roller is used. Gravel which retains a perpendicular face in the spring, and shows no trace of slipping when thawing out may generally be assumed to be sufficiently clean and free from clay for use on the road without any treatment other than is necessary to remove stones greater than one inch and a quarter in diameter.

BROKEN STONE.

There are localities in Canada where good gravel is not obtainable, but where stone can be had, either as bed rock or as field boulders. Some townships have used stone broken by hand, but a stone crusher, with a screen attachment affords a much cheaper method.

The stone should be separated into grades according to size, the coarser stone to be placed in bottom of the road, and the finer at the top. This grading of the stone is done by means of the screen attachment. If the stones are placed in the road without being graded in this manner, the smaller stones wear more rapidly than the larger, and a rough surface results. Large stones at the surface, moreover, are more apt to become loose, to roll under the horses' feet or the wheels. For a country road there should be placed in the roadbed (1) a layer of stones such as will pass through a 2½ inch ring; (2) on this a layer of stones such as will pass through a one inch ring; (3) on this a coating of screenings—that is, the dust and chips created in crushing.

Care must be taken in choosing the stone to be used. Some limestones make good metal; but limestone shales of a slaty nature, or limestones which decay rapidly on exposure to the air should be rejected. Sandstones are brittle and do not unite well in the road. Granites, which are found in the northern parts of Ontario, make good road metal. Trap rock is the best obtainable. Gneiss is very frequently a good rock. The latter with other hardstones, are frequently found as boulders scattered over the southern parts of Canada. In using field boulders, care must be taken to reject such stones as are evidently softened by exposure. Rocks which crumble readily under successive blows of a hammer, or which show iron stains when broken, should be discarded. A little experience will quickly teach a judicious roadman to detect boulderstone which is unfit for road purposes.

There must be a sufficient body of broken stone to consolidate into a compact layer. A sprinkling of stones over the surface is useless. It merely impedes travel on what might otherwise be a good dirt road. Six inches of broken stone is the least which should be used in making a durable roadway for any purpose, and it should be the aim of councils to thicken this covering as circumstances will permit.

PLACING THE ROAD METAL.

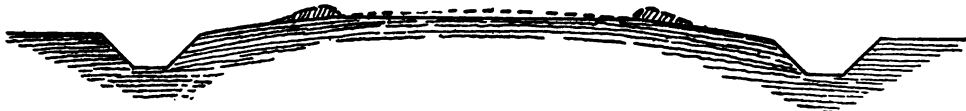
To know how gravel or stone should be placed on the road, it is necessary to have a knowledge of why it is placed on the road. This is a matter to which very few of our road-makers have given the slightest attention, and very few could give an intelligent answer to the question. The popular idea is that the stone makes a sort of carpet for a while, in a short time it will be forced down into the soil to form a bottom, and on this more gravel or stone will have to be placed, and that this process will have to be continued indefinitely until a good road is made. There is even a very general belief that it is not necessary to drain a road, but that the only means of accomplishing the desired end is to pile on gravel year after year, and that water, unless it actually floods over the top of the road, has little to do with the matter, and that so long as the actual surface of the road does not get wet it does not matter how boggy it may be underneath.

In the intelligent construction of a road, the intention of the gravel or stone coating is to form a waterproof covering for the soil underneath as well as to form a hard wearing surface. Of course, gravel and broken stone can not, as a matter of fact, be entirely impervious, but so far as the coating of these materials does prevent the water passing through to the sub-soil, it fulfills the greatest portion of its mission.

To accomplish this to the greatest possible extent there are several points which it is necessary to pay attention to: (1) The road must be crowned or rounded up in the centre. (2) The material must be as compact and solid as possible. (3) The surface of the road must be smooth.

CROWNING THE ROAD.

By having the road crowned or rounded up in the centre, water is at once thrown to the sides where it can be carried away in the drains. If the road is flat on top, or if hollow, as many of the roads of Canada are, water stands on the road, soaks down through the road covering and softens the soil beneath. Then the trouble begins. There is nothing to support the gravel, so that when a loaded vehicle passes over it the wheels are forced down through the gravel and into the soil. The soil is plowed up, mixed with the gravel, and the serviceability of the road is largely destroyed.



"TURNING THE LOOSENED DIRT TO THE SIDE."

The means of providing a proper crown must depend on circumstances. For an average country road on which a grading machine is used, the best method will be to first round up the natural soil giving it a slightly less crown than it is intended the finished road shall have. This completed, pass the grader over one side of the centre cutting off the top and turning the loosened dirt to the side, then pass the grader back along the other side turning the loosened dirt to the side. This will leave a flat surface



THE GRAVEL IN PLACE.

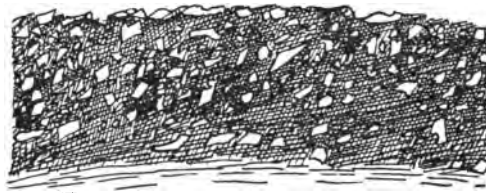
in the centre of the roadway, along each side of which is a shoulder of loose earth, forming a shallow trench. In this the gravel should be placed, spread with a rounded surface and the loose dirt at the sides levelled off to conform to the shape of the roadway.

Old gravel roads are commonly flat, in ridges, with square shoulders at the edge of the ditches. In this case the better plan is to cut off these shoulders throwing the loosened earth outward. The ditches are usually very wide and flat, the road having been graded by drawing the earth out of the ditches with a scraper, so that the shoulders thus turned outward merely widen the graded roadway without interfering with the drain. If, however, these ditches are sharp and deep, the loosened earth may drop down so as to obstruct the water, in which case it will have to be thrown across the drain to the roadside by hand, a proceeding seldom necessary.

Usually a sufficient depth of gravel will be found upon these roads, requiring only that the centre should be raised by cutting off the sides. After this is done as above described, a light coating of clean gravel to fill the ruts and depressions and restore the crown will make an excellent road.

CONSOLIDATING THE MATERIAL.

The road covering should be solid and compact in order to shed the water. Under present methods, the gravel or stone is dumped in the centre of the road and is left as it falls, a mound of loose material, avoided by the users of the road until late in the fall when the muddy and rutted state of the side of the road compels them to drive along

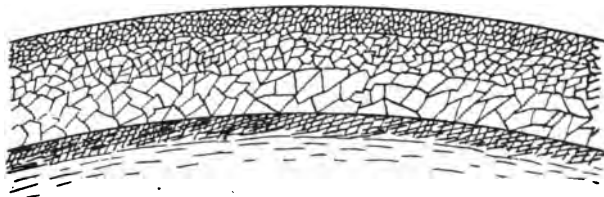


"MIXED WITH THE SOIL BENEATH."

this mound. Gradually it is flattened down and after a year or so, during which time it has been mixed largely with the soil beneath, it assumes the shape of a road. The utility of roads made in this way is largely wasted. Roads must be made for traffic not by it.

This loose stuff absorbs the rain as it falls even before it is cut into ridges by wheels and the feet of horses. When it has been cut into this condition it acts as a receptacle to hold all the moisture its surface will receive. In this way the whole surface and foundation of the road is softened, is readily cut up and destroyed.

The best remedy for this waste in road-making, is to spread the road metal to conform to the required surface of the finished road, and then thoroughly consolidate it by the use of a heavy roller. It can be largely remedied also by taking proper care of the



THE BROKEN STONE IS CONSOLIDATED INTO A DISTINCT COATING BY THE USE OF A ROLLER.

road, if a roller cannot be had. By raking the loose material into the ruts and wheel tracks as fast as they appear, nearly the same end will be accomplished but less perfectly and requiring a longer time. The first vehicle passing over the road does comparatively little injury; it is when ruts have been formed which hold water and other wheels follow in these tracks that the greatest damage is done.

A SMOOTH SURFACE.

It is evident that a smooth surface is essential to a good road. A rough surface is necessarily such as will impede the flow of water from the centre to the drains. To such roads rain is always an injury. With roads properly built, on the contrary, a good dash of rain will flush away the dust which has accumulated, and which, if it remains on the road in time of steady rain and slush, acts as a sponge to absorb moisture and soften the surface of the road.

KEEP THE ROAD DRY.

Keep the roads dry, and with very little attention they will remain good roads. A little moisture does comparatively little injury. Against some moisture it is impossible to guard. But with proper precautions the excess moisture can be removed before great damage is done. The means to be taken with regard to the actual surface of the road have already been commented upon.

THE OPEN DRAIN.

The open drains at the sides of the road should be sufficiently deep to hold water in times of freshets, and should have a sufficient fall to carry it quickly away. The fall should be uniform, not a series of rises and falls, knolls and holes.

Most important of all, in view of the neglect which it receives, the outlet must be ample and always free from obstruction. It is useless to dig a drain without providing an outlet for the water, a thing very commonly done. The water merely stands in the trench, soaks into and softens the roadbed. Unless a drain carries the water away it is useless.

THE FOUNDATION.

The importance of keeping the roadbed dry cannot be too thoroughly impressed. Clay in thick beds, when dry, will support from four to six tons per square foot of surface, according to the quality of the clay. If only moderately dry it will support only from two to four tons per square foot of surface. If the clay is wet and soft it will yield to almost any load. Gravel, if well compacted, forms a much stronger roadbed, is less yielding to the action of moisture, and for this reason, even for a thin surface coating, strengthens the road somewhat. But the real strength of the road must lie in the sub-soil. Vegetable moulds and alluvial soils are weak, having a sustaining power of only one-half to one ton per square foot, and for this reason it is well to remove such soils, securing, if possible, a gravel, clay or sand foundation.

UNDERDRAINING.

In order to keep the roadbed dry and secure a strong foundation, it is frequently advisable to use tile underdrains. Owing to the weakening effect of water on clay, also to the retentive nature of clay, that soil is usually most in need of underdrainage. In gravel and sand water is not ordinarily so destructive unless when acted upon by frost; at the same time these latter soils usually provide better natural underdrainage, as they are more porous, and artificial means of underdrainage are usually less necessary.

Under-drainage may be had by means of common field tile. It is usually best to place two such drains, one on each side of the roadway underneath the open drains. One tile drain placed underneath the centre of the roadbed is sometimes used. The extra cost of two drains is largely reduced, however, by the lesser cost of excavation, since, on the majority of road allowances, deep open drains now exist, and the soil is softer and more cheaply handled than that in the hardened centre of the road. It is very unwise to excavate and soften the hardened centre of the road when it can be avoided, as settlement is

very slow. At the same time, two drains are more effective, carrying away water more rapidly and thoroughly. They intercept the soakage water from the adjoining land before it passes under the roadbed.

Any thoughtful farmer who knows the effect of underdraining in his field will at once recognize its usefulness in road-making. In the fall, water will be rapidly removed from the bed of the road and the destructive action of frost lessened. In the spring the frost will come out of the ground more quickly, and each of those periods in fall and spring are shortened, when, with the foundation and surface thoroughly saturated, the roads are not only impassable on account of the mud, but are injured by traffic more than in all the remaining nine or ten months of the year. One year's statute labor with the annual appropriation, spent in providing proper drains for the roads of the Province would do more than can be done in five years with the present method of merely filling the holes which appear, with gravel or crushed stone.

Underdraining and grading should be carried on simultaneously. Unless drained, the traffic during the ensuing autumn and spring will usually leave a graded road as shapeless and rough as a pioneer wagon track can be. If drained, there will be a foundation for the gravel or crushed stone to rest on when applied.

A porous soil, like a sponge, retains in its texture, by attraction, a certain amount of water. When water in excess of this is added it sinks to the first impenetrable strata, and from there it rises higher and higher until it finds a lateral outlet; just as water poured into a pail will rise higher and higher until it finds an outlet in the side of the pail, or until it flows over the top. Underdraining supplies the necessary outlet for this excess moisture at a proper depth from the surface; "it lowers the water line."

With plastic clays the process is slightly different. Clay will absorb nearly one-half its bulk and weight of water. In drying it shrinks and is torn in different directions. The fissures thus commenced by a tile drain become new drains to lead water to the tile; and so the process of contracting and cracking continues until a net work of fissures is produced, and the stiffest clay is thereby drained.

THE EFFECT OF FROST.

The injury done to roads by frost is caused entirely by the presence of water. Water expands on freezing, and the more there is under a road, and above frost line, the greater is the injury. The particles of soil in immediate contact with the water are first compacted. When room for expansion ceases within the body of the soil itself, the surface is upheaved. When thawing takes place the sub-soil will be found honey-combed, ready to settle and sink beneath traffic. It is therefore of the utmost importance that the soil should be relieved of the water of saturation as quickly as possible by underdrainage. The impassable condition of most roads in Canada during the spring, often axle deep in mud, is to be attributed very largely to a wet sub-soil which has been honey-combed by frost.

MAINTENANCE.

It is not merely necessary to make the roads good; they must be kept good. It is not sufficient to provide drains; care must be exercised to keep the drains open and free from obstructions. It is not enough to merely place the gravel or broken stone on the road as it ought to be placed; care must be taken to see that the covering is kept in place. It is not sufficient to build culverts; it is further necessary that the culverts be kept in order. It is folly to build roads properly if they are afterwards neglected and allowed to remain out of repair. Every farmer knows that if the repair of his barns, his outhouses, and his fences were neglected as is the repair of the roads, a great personal loss would result.

Probably one of the greatest defects of the present system of road construction is that the roads are not repaired when the need of repair first arises. Unless in a very dangerous state, work is done on the roads only once a year at the time of performing

statute labor ; ruts, hollows and other defects are permitted to remain without attention, and when these defects commence they increase with great rapidity. Culverts are permitted to fall to pieces for want of repair at the proper time. Drains become obstructed, and the roadway is allowed to be flooded and saturated for want of a little timely attention.

It is absolutely essential to the maintenance of a good and economical system of roads that provision be made by the township for their repair as soon as signs of wear appear. However extravagant it may appear at first sight to recommend that a man be constantly employed to go over such a mileage of roads as he can attend to, devoting his whole time to the work, there can be no doubt that it would in the end be the most economical plan. It is the same system pursued by railways in the care of their roadbed, and railway corporations are noted for their economical methods.

A man constantly employed in this way could fill up ruts and wheel tracks as soon as they appear, before water has been permitted to stand in them to assist in deepening them. A decayed plank would be removed from the culvert or bridge before an accident was caused thereby, and before the weakening of the bridge at this point had caused other portions to be destroyed. An obstructed drain would be opened before injury had resulted to the roadway. Loose stones would be removed from the road where they are rolling under the wheels and feet of horses. Loose gravel and stone would be kept raked into place until it had become consolidated. By these and many other simple means the roads would be at all times kept in a more serviceable condition, and of greater importance, repairs would be made in time to save the road from injury which could not be remedied ; and in time to save much labor and expense in making possible repairs.

Some municipalities have adopted the plan of employing a foreman and a couple of laborers to devote their whole time to the roads of a district or township, and in such cases a grader and other road machinery is employed. Whatever the details of the system, the principle should be the same throughout, that wear must be repaired as soon as signs of it appear, if economy and good service are to be had.

ROAD GRADERS.

A road grader is one of the most necessary implements for a township to possess. To depend upon manual labor for the first grading of roads, and the repair of others that require re-shaping, is a useless waste of labor and money. Improved road machinery is as great a saving in road-making as is the self-binder or the steam thresher in farming operations. To neglect the use of a road grader is as unwise as it would be to return to the old time cradle and flail. If every ratepayer took the same personal interest in the roads that he does in his farm, no municipalities would be without modern machinery for roadwork. The grader in the hands of a skilful operator will do the work of fifty to seventy-five men in grading and levelling the roadway.

A ROAD ROLLER.

A most valuable implement in road construction is the road roller. On town streets it is indispensable. To thoroughly consolidate the gravel or stone into a smooth, hard layer, before it can be mixed up with the sub-soil, renders the surface coating more durable and serviceable in every way. A steam roller of ten tons is too expensive for the majority of rural municipalities, but in some instances, townships could rent from a town in the district which owns one. A horse roller of six or eight tons is less expensive and some municipalities may see fit to purchase. In the construction of broken stone roads the loose stone consolidates under traffic less readily than does gravel, and without rolling remains for some time very loose and rough.

A STONE CRUSHER.

Wherever good gravel cannot be had, and where stone for crushing is obtainable, a stone crusher is most useful. Stone can be broken by this means at a price within the range of every well populated township, although a very expensive work when performed by hand. A crusher can be operated by the steam engine used for a threshing machine, which can generally be rented.

A rotary screen attached to the crusher will separate the stone into grades according to size, ready to be placed on the road in layers, the coarser in the bottom of the road.

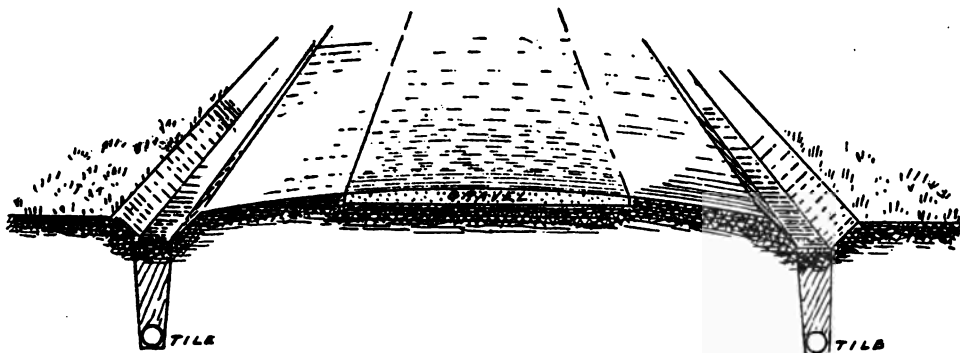
WAGON TIRES.

It would seem as though in everything the present methods in regard to roads in Ontario are contrary to good judgment. Gravel or broken stone is dumped loosely, without even spreading, on a badly graded, badly drained sub-soil. In the use of these roads the same recklessness is glaringly apparent. When wide tires have universally replaced the narrow tires which are now found on farm wagons, a great part of the road question will be solved. Narrow tires of two and one-half inches in width have only one-half of the bearing on the road which would be provided by tires of proper width. By referring to the supporting power of soils discussed in the paragraph on "Foundations," the effect of this is more apparent. By the use of a six inch tire, the roadway will support, without yielding, twice the load which it could support with a three inch tire.

Narrow tires cannot be too strongly condemned. They cut and grind the road, plow and upheave it. Wide tires, on the contrary, are a benefit rather than an injury to the road, inasmuch as they act as rollers to preserve a smooth, hard surface. In some localities wide tires are objected to under the argument that they increase the draft required to move the load. This may occur under certain occasional conditions of very wet and soft roads. But when wide tires are universally used this objection will disappear, as the increased draft is due to the ruts and mud caused by narrow tires.

DIMENSIONS OF ROADS.

For the average country road, a graded roadway twenty-four feet in width between the inside edges of the open drains, will be ample to accommodate travel. For the average road, if the central eight feet is metalled with gravel or broken stone, it will be



"FOR THE AVERAGE COUNTRY ROAD."

sufficient. The depth and width of the open drains will have to be governed by circumstances. Sufficient capacity must be provided to carry away all surface water. The depth must be dependent also on the fall obtainable. With tile under drains, deep open

ditches are not needed to drain the road foundation. The use of tile does away with the deep and dangerous open ditches which may otherwise be necessary. The crown of the road should be such as to give a fall of one inch to the foot from the centre to the edge of the ditch.

HILLS.

Hills are among the difficult portions of the road to construct, and are a constant source of expense for repairs. The reason of this usually is, that the drainage is imperfect. Water is brought long distances in open drains by the roadside, and poured over the hills, frequently to flood over the whole surface. It is not uncommon to find the centre of the road over the hill lower than open drains at its side—if there are drains at all. The natural result is that washouts are constantly occurring. For conditions of this kind the simple remedy is to dispose of the water before it reaches the hill, by conveying it through the adjoining fields if necessary. The probability is that a great amount of water has been carried in deep ditches past watercourse after watercourse in order to dispose of it over the hill, thereby avoiding the necessity of constructing drains through farm land in the natural watercourses. The secret of successful drainage with respect to roads, is to dispose of water in small quantities before it can gain force and headway.

Another common occurrence is to find water oozing from the surface of the road on hills. This is especially noticeable after the frost leaves these spots. The surface is soft and spongy and is cut readily by wheels. Such hills should be drained by placing a line of tile down each side of the roadway between the gutter and the gravel, carrying these underdrains to proper outlets. Cross drains should be laid in the wet spot leading to the side underdrains in a diagonal course. Well concaved gutters should be made on each side of the roadway, and at regular intervals catch basins should be placed to arrest the flow of water in these gutters, leading it into the tile underdrains.

The roadway on a hill should be well crowned. This will draw the water quickly to the drains at the side of the road, instead of permitting it to follow the wheel tracks, deepening them to ruts.

LOCATION OF ROADS.

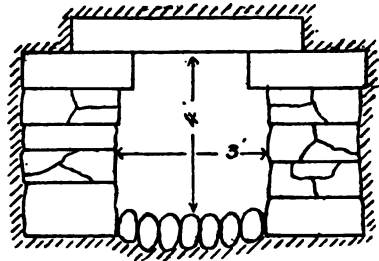
There are very many instances where, by changing the course of a road slightly, municipalities would save a large sum in construction, and at the same time produce a better road. A slight deviation would frequently avoid swampy or wet ground, or would do away with the necessity of expensive cuts and fills. A hill can sometimes be avoided or the grade very much reduced by altering the location of the road. There is a prejudice against taking the roads from the lines laid down in the original survey, and property owners prefer to have their farms bounded by straight lines. At the same time the value of good roads to the farm should not be overlooked, and whenever a change in the road allowance means the change from a bad to a good road, or a change from a steep to a gentle grade, the slight inconvenience created by the alteration of boundary lines will be many times repaid.

CULVERTS.

In no branch of municipal work is so much money wasted as in the construction and maintenance of sluices and culverts. In most townships these are built of timber.

Timber is perishable, culverts are subjected to repeated changes of wet and dry weather, the severest test to which timber could be subjected. Each year a large number of these culverts are renewed at a cost of from \$5 to \$50 each, in some townships aggregating from \$500 to \$1,500, and this is an annual outlay. The life of these structures is so short that it is not more than five years before repairs are required, and these repairs

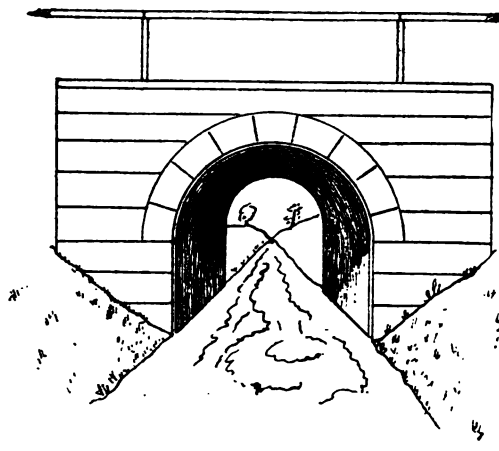
in a short time amount almost to renewal, and that of the most expensive kind. A broken plank, or stringer, a rotten log or any timber replaced with new at different periods, makes the maintenance very costly, and this class of structure the most temporary and expensive. No sooner have they all been rebuilt than we must again com-



FOR SOME LOCALITIES A CHEAP, STONE CULVERT OF THIS DESIGN WILL ANSWER.

mence the reconstruction of the first; in this way the expenditure becomes perpetual, and fixes a large percentage of our annual tax. If these culverts are in their proper locations, natural watercourses and other fixed places, they will always be required, and their construction in the most durable manner is the best and most economical plan.

For small culverts there is very little difference in the cost of timber and vitrified pipe. If properly laid the latter will withstand the frost and is durable. These pipes may be used up to eighteen inches in diameter, and the capacity may be increased by laying two or more rows, but the pipes should have at least one foot of earth or other filling between them. Culverts of five or ten feet span should be cement-concrete arches, which is permanent if the concrete is properly made. The concrete should be composed of first-class cement, clean, sharp, silicious sand, free from earthy particles and coarse enough to pass through a twenty mesh, and be retained on a thirty mesh sieve; clean gravel screened through an inch and a half screen, the largest stones to be not more than two and one-half inches in diameter; or, in place of gravel, broken stones that will pass



A CONCRETE CULVERT WITH WING-WALLS OF CONCRETE.

through a two and one-half inch ring. These materials should be mixed in the proportion of one cubic foot of cement, two cubic feet of sand and three cubic feet of gravel or broken stone, with just enough water to make the whole into a plastic mass. The sand and cement must be first mixed dry, then a sufficient quantity of water added to make it

into a thick paste. It should then be thoroughly mixed again, spread out, the stone or gravel added, and the whole thoroughly mixed until every stone is coated with the mortar, then put it in place. The walls should extend well below the frost line and have a wing at the ends to protect the embankment from wash.

BRIDGES.

Wooden bridges, except where timber is very plentiful in the immediate locality, are not a good investment in view of the reduced cost of iron and steel, and the increasing cost of timber. Timber decays quickly, and while cheaper than steel in first cost, is more expensive after a term of years, since the cost of repairs is very great.

Generally speaking, the cost of an iron superstructure is more than that of wood. The substructure of stone or concrete is more expensive than pile or crib work, but as in other structures, a firm foundation is most serviceable and economical. Wooden foundations, from decay and other causes, settle, and the least settlement in the foundation twists the timber, causing a disarrangement of the strains, frequently transferring the greatest load to the weakest point. Wherever timbers have a seat or bearing exposed, decay soon commences, and when least expected the bridge collapses under a heavy load.

Wherever timber is used in bridges it should be in members of from four to six inches in thickness, the strength of the beam or cord being obtained by building several members together, breaking joints, and coating each bearing with lead. A further protection is to cover these built timbers with galvanized iron to protect the numerous joints and bearings from moisture. All caps, corbels, chords, braces and floor beams should be made in this way so that the thickness of no timber will be more than six inches. A wooden bridge should be painted one year after erection; an iron bridge at the time of erection, and care should be taken to see that they are kept painted and that all nuts are kept tightened so that each member may carry its fair share of the load.

The cost of renewing a wooden bridge, in which a man has to be sent to put in a new timber from time to time, will amount to twice the initial cost of the bridge. In this way the ultimate cost of a timber structure becomes very great.

The course pursued by some, indeed most municipalities, in erecting iron bridges is likely, however, to result disastrously, and throw iron and steel into disrepute. A council advertises for tenders. The companies responding supply their own plans and specifications. Thus far the procedure is entirely satisfactory. The difficulty arises when councils accept the lowest tender without obtaining the advice of an experienced builder of iron bridges as to the plans and specifications submitted. This is a matter in which few township engineers and surveyors are qualified to decide, and certainly the wisdom of councillors entirely without professional training in such matters is not to be trusted. Cases have occurred in which a difference of five dollars has influenced a council to accept a tender for a bridge which was manifestly, to a man of experience, worth less than the other by several hundred dollars; and which was indeed unsafe, offering every likelihood of failure with attendant loss of life and great expense for reconstruction. It is difficult to understand the action of councillors, shrewd in other matters, in the construction of bridges and other public works proceeding with such apparent disregard for the true interests of those whom they represent. A small sum spent in securing reliable advice is as much a matter of economy in public as in private affairs.

IN BRIEF.

Roads that "break up" are bad roads.

Make road improvements in such a way that they will be permanent.

Whether by statute labor or other means undertake road work systematically.

Appoint a supervisor who will have charge of all the road work.

Make road beats five miles in length, choose the best men as pathmasters, and keep them in office.

Classify the roads according to the nature and extent of traffic over them.

Specify the width of grade, amount of crown, plan of drainage, kind, width and depth of material to be used, and see that these specifications are carried out.

Purchase gravel by the pit, not by the load.

Use clean road material.

Strip the clay and earth from over the gravel pit before the time of performing statute labor.

If screening or crushing is necessary let this be done before the time of statute labor.

Do not scatter money in making trifling repairs to temporary structures.

If statute labor is to be made successful the work must be systematically planned and some definite end kept in view.

Have the work properly laid out before the day appointed to commence work. Call out only a sufficient number of men and teams to properly carry out the work in hand and notify them of the implements each will be required to bring.

Let no pathmaster return a ratepayer's statute labor as performed unless it has been done to his satisfaction.

In justice to others, make the returns clearly, showing what work has not been done.

See that the council collects the amount from the delinquent parties and have it expended the next year.

The pathmaster should inspect the roads under his charge after every heavy rain-storm. A few minutes' work in freeing drains from obstructions, filling holes, diverting a current of water may amount to several days' work if neglected.

With the money which can be spent, build permanent culverts, permanent bridges, buy machinery, buy gravel pits, prepare gravel for hauling, construct drains, operate the machinery.

Use the statute labor as far as possible in drawing gravel or broken stone.

Do not leave the gravel or broken stone just as it drops from the wagon. Spread the metal.

Crown the road with a rise of one inch to the foot from side to centre so as to shed water from the roadway to the drains.

Give the open drains a good fall to a free outlet. Lay tile underdrains where needed.

Drain thoroughly. Keep the road surface dry. Keep the earth underneath the surface dry.

Use road machinery.

Use graders, stone crushers and road rollers.

Improved machinery is as necessary for good and economical work as are self-binders and steam-threshers.

Employ a man to take charge of the machinery. He will become experienced and do better and cheaper work.

The same teams should be employed to operate the graders. They become accustomed to the work and give better service.

Do not cover an old gravel road with sod and earth from the sides of the road. Turn this earth and sod outward and raise the centre with new gravel.

Adopt every means to secure a hard, smooth, water-proof surface.

Do not let stones roll loosely on the road.

Do not let ruts remain. They make travelling difficult, and spoil the road by holding water.

Make repairs as soon as the defects appear.

Use wide tires.

Improve the drainage of the hills. Make the crown of the roadway higher than on level ground.

Change the location of the road if a steep hill can be avoided.

Do not use wood for culverts. Use concrete, vitrified pipe or stone.

Do not build wooden bridges. Use iron, stone or concrete.

Build good roads.

THE GOOD ROADS MOVEMENT.

The demand for better roads is one which is far reaching and urgent. From Nova Scotia to British Columbia the question is being discussed and active measures are being taken to place road improvement on a more satisfactory basis. Throughout Canada statute labor still prevails but in all the provinces evidence is not lacking to show that a change in this regard will take place within a short term of years. It is not a matter in which any of the legislatures are likely to interfere until the people themselves make such changes as the power with which they are now vested permits. The legislatures are, however, using educational means to influence the people to better their condition in this respect. Ontario and Quebec have appointed commissioners for this purpose. In New Brunswick and Quebec the provincial governments are granting aid to the Good Roads Associations and in the actual construction of roads, chiefly, as yet, for educational purposes. In Nova Scotia measures are being advanced leading to the expenditure of Provincial grants, and to regulating the width of waggon tires. Manitoba has as yet taken no active steps, but in the North West Territories organization has been given to a statute labor law and in British Columbia the agitation is brisk.

The movement has grown out of actual conditions. The roads are bad. They are the result of a certain system. That system is therefore insufficient, and better methods are being sought. There is no desire on the part of any to increase taxation. The reverse is entirely the case. But where taxation may be increased to a slight extent, it is claimed, and fully substantiated, that the amount of taxation is many times made up by profit derived from the improved roads. The movement is on a firm basis, is one which is supported by the best economic principles borne out by the experience of other countries.

The possibilities of agriculture in Canada are unsurpassed by those of any country of the world. A comparatively small proportion of our land available for farming purposes, is under cultivation; and such lands as are under cultivation are rarely productive to the full extent of their ability. To enable us to receive the greatest advantage from the resources surrounding us, there is every need that the portion of the community engaged in farming shall be provided with the best machinery of agriculture. This does not consist merely in the seeders that assist in sowing; the threshers that separate the wheat from the chaff. To obtain sale for his produce at the highest price is equally important for the farmer with raising his produce cheaply and of the best quality. The former, however, is a matter which the farmers have too long neglected, too long left to the good will of others. The real market of the Canadian farmer is not the railway station or country town where he delivers his produce. The price of the article is fixed at the great distributing centres in accordance with law of supply and demand. The

amount received by the farmer is the price at the distributing centres, less the cost of transportation. To realize increased profits, the farmer must produce more cheaply and transport more cheaply. The first part of the carriage is entirely in the farmer's hands.

The first link in the chain of transportation, the country road, is abnormally expensive and inefficient. To remedy this is to assist very materially in improving agricultural conditions, and in a great measure increase the prosperity of the country as a whole. There is not an industry nor profession which would not be benefited by good roads, for the basis of Canada's wealth is agriculture. The State of Massachusetts is one of those which has taken most advanced steps in road improvement. On petition of a county, the State road commission may, with the assent of the Legislature, adopt any road within the county as a State highway. Except that the grading and bridging is done by the county, the work thereafter, both construction and maintenance, is under the authority of the state commission. Also on petition of two or more cities or towns, a road between them may be made a state highway. The "State Commission" is composed of three commissioners who compile statistics, make investigations, advise regarding road construction and maintenance, and hold public meetings for the discussion of road matters. One-fourth the cost of construction is paid by the county, the remaining three-fourths being paid by the State. In 1894, the State spent \$300,000 in this way; in 1895, \$400,000; and in 1896, \$600,000. It is intended that ultimately about one-tenth of the entire road mileage shall be built in this way.

In Michigan, upon a majority vote of the ratepayers in any county, a county road system may be adopted. A board of commissioners, five in number, are elected by the people to lay out, and construct certain of the leading roads, to be paid for and thereafter maintained by a county rate.

A bill has just passed the New York State Legislature providing that, on petition of a county council, certain roads may be adopted as state roads. The petition is first presented to the State Engineer. If he approves of the section of road thus sought to be improved, he prepares plans, specifications and estimates. These are presented to the legislature and if approved by that body, fifty per cent. of the cost of construction is paid by the state.

The New Jersey Highway Law provides that, on the petition of the owners of two-thirds of the land bordering on a road, the state Commissioner of Public Roads will cause the road to be improved in accordance with plans and specifications prepared by him subject to the approval of the Legislature. The owners of the land affected by the improvement pay one-tenth of the cost; the county pays six-tenths; and the state three-tenths.

Connecticut has introduced a plan of highway improvement providing for the appointment of three state commissioners. When a township votes in favor of constructing a road under the provisions of the State Highway Act, specifications are prepared and submitted to the state commissioners. If the commission approves, the township council lets contracts for the work to be performed under the supervision of the state commissioners. One-third of the cost is paid by the state; one-third by the county; and one-third by the township. The expenditure by the state in this way is limited to \$75,000 annually.

The State of Rhode Island has appointed a Commissioner of Highways. When a council represents to the Commissioner the need for improving a certain road, an examination is made by him. If he considers the work necessary he prepares plans, specifications and estimates, and reports to the municipalities affected, also to the State Legislature as to the proportion in which the expense should be met by the state, and the municipalities benefited. If the State Legislature approves, the work is performed by contract.

Vermont and California also contribute largely in the form of state aid, while Indiana, Kentucky and others contribute in a less degree. Only the bare outlines of the systems have been stated with the object of showing the prominence the question of road improvement has attained of recent years. All the above legislation has been adopted

within the past five years. In all these systems safeguards are placed to prevent the expenditure exceeding, for any state or any locality, certain reasonable limits, according to requirements and ability to meet the payments. In most of these states, the tax is so levied that the towns and cities pay the greater proportion of the cost of state road construction; for example, in the State of New York, it is estimated that the people outside of the towns and cities will pay only 10% of the cost.

The last report of the Wisconsin League for good roads concludes with the following summary :—

"Interest in the crusade for better roads has again made great progress during the past year. Road machines are multiplying in number, better methods are gradually being adopted, the sentiment for substantial macadam roads is growing rapidly, and it may truly be said that the work of the League for Good Roads during the past two years has borne fruit. Still, only a beginning has been made during those two years. We must continue in our efforts to bring about state aid to road building, which is the best practical method of securing the construction of short pieces of model road in each country, to serve as object lessons. Such pieces of roads would serve to teach the practical value of substantial highways, and would give a wonderful impetus to the good roads sentiments. State aid to roads is employed in New Jersey, in Connecticut, Washington, Rhode Island, Vermont and Massachusetts. Public sentiment in Wisconsin seems to be drifting to state aid as the most practical reform in connection with road building. Our league has the heartiest co-operation of the farmer's institutes, the agricultural societies, the public press, and of many organizations whose character permits them to aid in our work. With the continued assistance of our members who have manifested their interest upon numerous occasions, we believe confidently that our organization will continue to succeed in its labors as heretofore."

The inducements offered to municipalities by the Provincial Government of Quebec, are stated in a circular issued from the Department of Agriculture. While the means adopted may in a measure be termed "state aid," they in effect are similar to those of Ontario, in as much as they encourage the people themselves to undertake the work; are educative in results, rather than affording substantial assistance such as is generally understood by "state aid." The circular is as follows :—

"In 1897 the Department of Agriculture inaugurated a new policy for encouraging improvements to roads by granting aid to rural municipalities to enable them to purchase special machines for repairing roads.

Notwithstanding the bad weather that prevailed during the summer and last autumn, and was unfavorable for effecting repairs to roads, the results obtained have been most satisfactory. Seventy-seven municipalities have had their names entered so as to benefit by the advantage offered them, and according to the official reports received up to date at the Department of Agriculture, over 150 miles of road have been repaired since last June.

These results justify the Department in carrying out the system inaugurated last summer with the few following modifications :—

A special grant of \$300 was placed last summer at the disposal of each county, to be divided into premiums of \$125, \$100 and \$75 between the first three municipalities that availed themselves of the same. The same grant will be given this year to the counties which shall have claimed it in whole or part between this and the month of July next.

In counties where the total amount of \$300 shall have been distributed between now and July, the Department will again grant from and after that date three premiums of \$75 each to the first three municipalities applying for the same. If a single municipality in a county has then availed itself of the offer made to each county, the department will place at the disposal of the same county a bonus of \$100 and two of \$75.

Moreover, in order to encourage the stoning of roads, the Department has decided to grant each county municipality, aid towards the purchase of stone breakers with engine, roller, and sorter, provided that the total cost of such machines do not exceed \$2,400 per county. An amendment to the Municipal Code, passed during the last session of the Legislature, authorizes county councils to make arrangements with each parish, village or town municipality of the same electoral division, for repairing the roads in those various municipalities. The general act respecting town corporations has likewise been amended in the same sense.

Municipal councils of parishes or of counties desiring to avail themselves of the above advantages must draw up their application in the form of a resolution, a copy whereof must be sent to the Department of Agriculture. The premium to which they shall be entitled shall be

paid to them after at least two miles of earth road shall have been repaired, and after a certificate to that effect shall have been forwarded to the Department with a copy of the invoice from the company that sold them the machines.

In the case of the purchase of a stone crusher, half a mile of macadamized road must have been completed and accepted by an officer of the Department of Agriculture, before the Government contributions shall be paid.

Machines for repairing earth roads that are bought by the municipalities, with the help of the Government, shall remain the property of such municipalities for at least three years, and the county councils that purchase stone breakers cannot sell such machines before they have been at least five years in use in the same county."

MUNICIPAL REPORTS.

During the year an effort was made to secure reliable statistics from municipal clerks respecting roads and streets throughout the Province. The importance attached to the question of road and street improvement was evinced by the interest taken in the matter by municipal clerks. The replies to questions asked, in the great majority of cases, were painstaking, with an evident desire to give the fullest and most correct information. In spite of this, however, the lack of system which characterizes this branch of public work is so deplorable that nothing of a definite character, respecting the Province as a whole, can be tabulated. Very few municipalities have any records showing the number of miles of roadway to be maintained; some clerks could not even venture an approximate estimate. Scarcely a township could separate the expenditure on roads from that on bridges. Rarely could a reliable answer be given as to the number of miles of road improved in any year, or the amount of work done. In regard to the general condition of roads in any municipality, the majority of clerks affirmed that they were bad. Others believe that their roads compare very favorably with those of adjoining townships—not always indicative, it is to be observed, of good roads.

In towns, very much the same condition prevails. Only an approximate estimate of the street mileage could be given. Many could not state the number of miles gravelled or otherwise improved. While they could give the total amount spent on roads, sidewalks and bridges, very few could separate the items under these heads; nor had they any record of the work done in any year.

If the roads had received any kind of systematic treatment whatever, these are all matters which could be known without difficulty. The result of the enquiry is a most emphatic avowal of the neglect which road improvement, under present methods, has received. Councils are spending money in amounts which are very often large, but no proper record of the expenditure is kept. The money is merely scattered in patchwork and temporary repairs, and at the end of the year, for one thousand dollars spent in this way, very rarely can satisfactory results be shown. A proper record of the money and labor placed on the highways, together with the work performed, if presented to the people would be an important factor in correcting many of the slipshod methods which now prevail. The following is the circular sent to township clerks. Those sent to towns, cities and counties were of a similar nature:

DEPARTMENT OF AGRICULTURE, GOOD ROADS BRANCH, TORONTO, OCTOBER 11TH, 1897.

To the Clerk of.....

The information possessed by the Department respecting the roads of Ontario is of a very indefinite character; and in view of the importance of the subject, and the interest now being taken in road improvement, it is earnestly requested that you will favor the Department with replies to the questions in this circular. Kindly fill in the blanks as far as possible, and return in the enclosed envelope without sealing it. Any further particulars respecting the roads or road system of your municipality, not touched upon by the questions, will be gladly received.

A. W. CAMPBELL,
Provincial Instructor in Roadmaking.

1. What is the total road mileage maintained by the township ?
2. How many miles are metalled with gravel or broken stone ?
3. Is the road metal (gravel, stone, etc.) plentiful? What is the average length of haul ? What is the quality ?
4. Is statute labor employed ?
5. What number of days' statute labor was on the rolls in 1896 ?
6. What is the number of pathmasters appointed ?
7. What is the commutation rate ?
8. What number of days were commuted in 1896 ?
9. Is commutation of statute labor compulsory ?
10. What amount of money was appropriated by the township for roads in 1896 ? For bridges ? Total.
11. Is any aid received from the county ? If so, what amount was received in 1896 ?
12. Were any actions for damages brought against the township in 1896 caused by defective highways ? What was paid by the township in verdict, fees or settlement ? Are any such actions now pending ?
13. What roadmaking implements or machines are owned by the township, and when were they purchased ?
14. What extent of road mileage was graded or otherwise improved in 1896 ? In 1897 ?
15. What is the general condition of the roads ? Has any special effort been made recently to improve them ?
16. Further particulars :

CITIES, TOWNS AND VILLAGES.

The following extracts from reports received from the clerks and engineers of cities, towns and villages are of interest, and contain very suggestive statements. Special reports were asked from certain municipalities, which are also given :

BARRIE.

In 1896 the Council of the Town of Barrie voted an appropriation for the purchase of machinery and the construction of macadam pavements.

In that year and the spring of 1897 there was constructed 7,050 yards of Telford and 20,000 yards of simple macadam.

Under the Telford, the sub-grade was a light loam and sand, and under the macadam pure sand for the greater part of the way.

Some years previously there had been a specification drawn up for a Telford road, estimated to cost \$1.20 per square yard.

The authorities desired to put down a cheaper pavement, although there was no discussion as to discarding the Telford foundation.

The roadbed actually laid was a very substantial one, quite as heavy as the original design, but having cheaper features in the foundation and costing about half the estimated cost of the original.

The Foundation consisted of six to eight inches of field stone. The interstices were filled by the broken stone working into them. A large amount of broken stone was used in this way, but except where a swampy sub-grade or other reasons called for this procedure, I would not advise it, on the score of the attendant expense. It left a very open foundation no doubt and solid, but in general the gravel from the old roadbed might be hauled back to serve the purpose or else if that were not fairly clear, fresh pit gravel. This forms a good cushion also for the metal proper.

If excavation has to be made for the foundation, as would be the case in general on a built up business street, there is a certain amount of expense in that, but in cases the excavated earth serves as a fill, and where stone is as cheap as we had it here, the expense of the foundation,

for stone and setting the same, is but a small proportion of the total cost. Here, this item amounted to about ten or eleven cents per square yard, but the excavation and the broken stone to fill the interstices added considerably to the outlay chargeable to this portion of the work.

After a small piece of the pavement had been finished a tremendous rain storm swept it as clean and smooth as a floor and caused a citizen "*agin the Government*," to remark "I do not mind paying for a thing when it is well done."

The Road Metal was then spread in three grades, coarse, medium and screenings. The medium grade is practically the wearing surface, as the screenings are intended for binding only, but were only used over the top layer. Water was used liberally with the fire hose where possible, otherwise with the water cart used for sprinkling the town streets.

The traffic was never stopped. The best piece of work was done, however, on a section of road where the traffic could be diverted and plenty of water laid on from a fire hydrant.

The intention was, on our work, to make the metal on the crown of the road six or seven inches thick after compacting, and the edges four or five inches. I think that this was approximately obtained. It is false economy not to grade the sub-grade carefully, as there is a waste of stone otherwise.

We estimated that the stone as measured in the wagons and as paid for ought to cover the roadway, if placed unbroken, to a depth of about ten inches, so that an allowance—say 66 per cent.—ought to be made in calculating the stone required for a given area.

The circumstances were such as to prevent any very exhaustive tests being made, but it would appear that the stone when broken and measured separately, increased very little in bulk. As has been mentioned, the greater part of the simple macadam was laid on pure sand.

It was difficult to maintain a decent cross-section, as the wagons and carts bringing the stone and the ordinary traffic cut into the sub-grade, the soft sand spreading out almost like water. Generally, however, a thin crust was formed by spreading clay, gravel or sharp sand, as it could be obtained, and often the loam underneath the sods at the roadside, where cuts were made was spread over the sand, but when the expense of this is likely to be at all large, I would not advise it. Even if the lower stratum of metal is to some extent buried in sand, there is the weight and solidity of the stone to the good.

The stone placed as this soft sand was rather coarse and had a good many spalls amongst it. We considered that, owing to the soft bed, these spalls were not very objectionable. When the jaws, crushing plates or dies are worn a good deal, there is apt to be a large proportion of flat pieces. These can be broken by napping hammers, and should be broken if they do not rest directly on a soft bed such as I have described.

A new set of jaws will help the difficulty of spalls, of which, however, there will always be some, and the napping hammers will always be in requisition for the upper course at least.

Engineering. To provide ample time for preparing careful plans is common sense. Due notification to the corporation of changes of grade affecting properties will give them time to act expediently. A good deal more of the construction engineer should be seen on the road than was arranged for in our work. Engineering cost money to the client, but the expenditure is conservative and legitimate and always tends to saving in the end, often of large sums.

The Cost of pavements of this kind must differ widely according to the locality. The cost of the stone and of breaking it are factors, and these vary considerably—the first to the greatest degree.

We found that the 4,220 square yards of simple macadam constructed in the spring of 1897 cost thirty-three cents per square yard, including all repairs to machinery, oil, waste, etc., etc., and crushing plates, but not including depreciation, interest on capital, nor engineering. The excavation was not responsible for more than two cents per square yard. The amount to add for depreciation and interest might be estimated roughly at two cents per square yard on the supposition that say 15,000 square yards were laid per annum. See also under "*Machinery*" for cost.

Cleaning. The pavement on the main street has been swept by hand, a large stable broom having been used, with shovel and hand scraper, no labor-saving machinery having been purchased.

Expensive as this method is, the road lasts well under it, as it is dealt gently with. The low spots are kept filled and prevented from being worn deeper, while the whole roadway is left covered with a very light crust protecting the stone from abrasion.

The crust would be dust except for the use of the water cart, which is thus an important factor in the preservation of the pavement.

Gutter. A cobble stone gutter about four feet wide is perhaps the best and most economical to edge the roadway with in small towns. The cost will be from twenty-five to thirty cents per square yard if not grouted with cement. One advantage of cement is that grass cannot grow in the interstices; the removal of which from the gutter on streets of little traffic being an item of expense; otherwise, however, the gutter seems amply stable under the light vehicular traffic of small towns.

After the macadam has been laid it is a source of great annoyance to have holes pawed in it by standing horses, and the cost of the gutter is little if any more; the above price not including excavation and grading, which would have to be done to prepare for macadam. When the macadam is thoroughly compacted by travel, this source of annoyance is lessened very much, but not altogether obviated unless by a gutter of cobble stones, flag stones or concrete.

Machinery. The roller used was a five and one-half ton horse roller. We purchased two and one-half tons of pig iron to weight it with. The old jaws of the crusher may be used for that, but they are too heavy to place or replace at convenience.

In setting up the crusher it is a great matter to view the operation from a labor-saving point of view. Let gravity help the men to bring the stone to the crusher and the gang may be reduced to a minimum.

The regular screening attachment to turn out three grades was purchased with the crusher, consisting of an endless chain of buckets raising the stone to the revolving perforated drum, which is set up in a frame to which are attached chutes. We constructed larger chutes to hold a wagon load or more each, and the labor of shovelling up the stone was saved. Great care should be exercised in making everything convenient at first. Our crusher, although built to be convenient for frequent moving, was set up twice; the distance macadamized was a mile and a half.

It was set up solidly each time and a shed built for the engine. When wagons with stone to be broken came in while the crusher was running, they were unloaded directly on to the platform beside the man or men feeding. Otherwise the stone was wheeled on to the platform from the pile. The amount of money to be spent on labor-saving conveniences must be determined by the circumstances solely.

Since the product of the crusher as to amount varies with the size and hardness of the stone to be crushed, and also with the set of the crushing plates, etc., etc., the results obtained in one locality and under one set of circumstances cannot be offered as a guide for all localities and circumstances.

Turning to one test in 1896—Four loads averaging 2.67 cubic yards each were broken in an average of twelve and one-half minutes each, or at the rate of 12.78 cubic yards per hour. The greater part of the stone brought to the machine was field stone just as it was picked up, from say five inches in diameter to the limit imposed by the opening, viz., 6 x 14 inches. It is true that larger stones were often brought (although we endeavored to get the teamsters to sledge them to size before bringing), and a certain amount of sledging was always in order. One of the loads in the above test was all sledged stone (blue hard-heads, etc.,) measuring 2.85 cubic yards, weighing 4.06 tons, broken in fifteen minutes. The weight of a cubic yard as measured in wagon of this stone would be 2,850 lbs., but we might assume in general the weight of the ordinary field stone as picked up to average not far from 2,500 lbs. to the cubic yard.

In 1897 with another engine and not so much of the largest size turned out, a test shows that three loads averaging 2.41 cubic yards and 6,020 lbs., or three tons each, took an average of sixteen minutes to grind. The weight per cubic yard was 2,492 lbs., and cubic contents of a ton 0.80 cubic yard; rate per hour, 9.19 cubic yards or 11.46 tons. The product of the 7.24 cubic yards was 7.61 cubic yards of three grades measured separately. This latter consisted of 0.59 cubic yards of the first grade or largest size which passed out of the end of the drum; 4.63 yards of the second grade which passed through the two-inch circular holes in the screen; and 2.40 cubic yards of "screenings" which passed through the one-inch circular hole.

The product contained very little of the coarsest grade it will be noticed; while in the first case perhaps half the product passed over the screen.

However, the average per hour including delays of all kinds is much less. I find in 1897 that only six yards were broken per hour paid; and the cost, including breakages, (of which we had one of some magnitude) and accounts, and delivery on the roadbed, amounted to 43 cents per cubic yard unbroken, or 11½ cents per square yard. Stone cost us 37½ cents per cubic yard delivered at crusher. Deducting the expense of repairing, rebabbiting and all accounts, 34 cents would cover the cost of breaking and delivering per cubic yard on the road.

Concrete Walks. While the crusher was in operation 11,300 square feet of concrete pavements were laid. The screenings from the crusher were used for the concrete. It would

have been profitable to use some of the medium grade on a heavier walk. It is much easier to level the bed for the topping when the material composing the concrete is not very rough and so the workmen object to the latter quality.

Extra screens may be attached under the revolving drum referred to under "Machinery," so that the screenings may be passed over a five-eighth inch mesh. That which passes the mesh falls on a fine screen which removes the flour-like dust, and the clean stone and sharp sand passes to the cart to be taken to the mixing board to be used for the "fine" concrete or topping. The rough screenings with only the dust eliminated may be used for the rough concrete.

One of the pavements of a total depth of twelve inches, built on a sub-grade of porous soil, on a business street and turning out to be a thoroughly satisfactory job, cost $9\frac{1}{2}$ cents per square foot.

The foundation consisted of five or six inches of cobble stones topped with two or three inches of gravel to make eight inches in all; and the concrete consisted of three inches of "rough" and one inch of "fine."

The curb was of concrete six inches by fourteen inches, placed on a bed of small cobble stones and gravel, well tamped, six inches deep by twelve wide. This was considered better than making the concrete curb itself deeper to avoid frost as it made a drain and of course was much cheaper and quite solid. This sidewalk was designed for a business street and was ten feet wide. I am an advocate of three or four foot sidewalks on residential streets in small towns in order to procure the spread of permanent pavements by lessening the cost per lineal foot. The concrete may be lighter the smaller the "boy" or square. In place of laying three foot board sidewalk in out-lying districts I have been advocating the use of broken stone, nicely crowned, say four or five feet in width, but we have laid none as yet. There are a few hundred yards of gravel walk.

(Signed) ARTHUR G. ARDAGH,
Civil Engineer.

CORNWALL.

I do not know of any town in Canada, in which it is so difficult to construct a permanent street, as Cornwall. We have no gravel available, for one thing, and the sub-soil that we have here, is a sort of mixture of soapy clay and quicksand in which any material or metal sinks quickly out of sight.

The Town Council has for years past put tons of costly metal upon our streets, and each spring a small army of men was employed to keep our roads in some sort of shape, and many thousands of dollars have been spent in this way.

Upwards of thirty thousand dollars have been spent on one street alone in the past twenty-five years, and still our roads have always been very bad; some blocks being almost impassable, for even a moderate load, during the spring months.

This year, however, our Council decided to adopt the views set out in your various Bulletins, and set apart one block for experimental purposes.

The block selected was one having a great deal of heavy traffic over it, and one that we have always had great difficulty in keeping in shape.

The first thing we did, was to put down four inch tile drains on each side of the proposed street, and as the soil was very wet, we put in a number of diagonal drains. These tile drains emptied into a sewer at the end of the block.

After allowing about four weeks to dry the roadbed, we had our engineer lay out a roadway twenty-four feet in width.

The roadbed was then excavated to a grade line, the excavated earth being thrown on each side to form a boulevard. Instead of curb stones, we used what might be described as an ordinary pine plank.

This plank served three purposes. It retained the broken stone in the roadbed proper; prevented the loose earth from being mixed with the stone, and formed one side of the gutter. These gutters emptied into catch basins placed at the end of the block.

When our roadbed got dry we covered it with a layer of stone, broken to cubes of about two inches in size, to a depth of eight inches in the centre, running to six inches at the sides.

This as it was being put down we rolled thoroughly with a fifteen ton steam roller which the town of Brockville kindly allowed us the use of.

When this foundation was thoroughly compacted, we placed another layer of slightly smaller stone, four inches in the centre running to three inches at the sides, and also rolled this thoroughly, until the roller would make no impression.

Over this we sprinkled common field sand, and then turned our street sprinkler on, following up with the roller again. The water washed the sand into the interstice of the stones, and this packed by the roller, formed an exceptionally good bond. The street was kept closed two days longer to permit of its drying.

It now resists the wear and tear of traffic admirably and sheds water like the roof of a house. All our people are satisfied with the experiment, and are demanding that we continue this improvement.

I might add, that we get our broken stone from our County Council ; it is broken by the prisoners in our county jail ; we can get it in any size we wish, and at a very reasonable price.

There is a very strong feeling in our town that our Council for next year should buy a steam roller, and I am inclined to think the purchase will be made.

General regret is expressed that this system of making roads was not adopted years ago.

JOHN A. CHISHOLM,
Member of Board of Works.

STRATFORD.

The question of road-making has received considerable attention in the city of Stratford during the last year, and if the policy adopted by the present council is carried out in the future, it will result in decreased expenditure, through a saving in the cost of maintenance, and a vast improvement in the roads.

The expenditure in the past has been for the most part for maintenance, and very little permanent work has been done. The soil is clay and the gravel obtainable contains more or less clay, the roads are therefore uniformly bad in wet weather and require a coating of gravel each year to keep them from breaking up.

The money appropriated for street work, about \$12,000 per year, has been used up in patch-work and no improvement was possible so long as the ordinary system of expenditure by wards was followed.

It was recognized by the council of 1897 that no improvement or saving in expense could be made without a radical change both in policy and methods of doing work. Road-making machinery was therefore purchased, the money being taken from the appropriation for the year, and an engineer was appointed to advise the council and to take charge of the work and expenditure of the money.

The road-making machinery now in possession of the city consists of a fifteen ton road roller, a rock crusher with elevator and screens capable of crushing about ninety yards of field stones per day, and a reversible road grader.

The streets were graded, drained and macadamized during the latter half of the year 1897, and several heavily gravelled roads were broken up, regraded and rolled at a small cost.

It is found that much good work can be done on heavily gravelled roads by this method provided that the metal on the road is not too fine and that the grading is thoroughly done. Roads with a small depth of gravel or with worn out gravel cannot be much improved without the addition of a considerable quantity of new metal.

The council has decided that no permanent roads will be built until such time as all drains, sewers, water and gas pipes are put in, and all sewers that are now being put in have house drains put in at the same time. This work makes a grid of trenches on the streets ; but when once completed the roads will not require to be broken up again and the cost of maintenance of roads will be very small.

W. F. VAN BUSKIRK,
City Engineer.

INGERSOLL.

In response to a request in December last for information relating to the streets of Ingersoll, W. H. Jones, at that time mayor, writes :

You will remember we invited you up a couple of years ago to exchange views with you regarding certain improvements we were contemplating in our roadways, and our council was so impressed with the importance of the ideas you suggested that they determined to at once pur-

chase the necessary machinery and make a start toward the permanent work you had advocated. We bought a street roller, plow and stone crusher and elevator, and in order to educate our citizens as to the advantages of having good roads, we decided to take a block about fifty feet long by thirty feet wide on one main street, and build it according to your plans as submitted to us. We excavated the road bed for a depth of twelve inches and thoroughly rolled the surface until it was perfectly solid; we then put on five inches of broken stone and thoroughly rolled that course; then we put on another course of broken stone slightly smaller than the first course; and after thoroughly wetting and soaking it, rolled as before until the whole became compact. For our top course we put on a course of about a couple of inches of stone chips and dust, thoroughly wetting and rolling until the whole mass became as solid as cement, and making, as you are aware, one of the finest pieces of road that could be built. I may mention that before this was done this piece of road had given us very great trouble in the spring and fall, on account of it being so wet, and at times it was almost impassable for heavy loads, although for years we had been continually putting on gravel through the summer, and scraping it off as mud in the spring. I also wish to mention that after making one excavation we put down twelve-inch tile drains on each side of the road with catch-basins to take off the surface water, and the consequence has been that our citizens were so well pleased with the smoothness and durability of the road after a winter's traffic had passed over it, that when the spring came and they saw that there was not the slightest rut or damage done to it, they decided to at once go on and build the balance of our two main streets in like manner. A by-law was submitted to the people for \$10,000; it carried, and we have now nearly completed the work and I have not the slightest doubt that when finished we shall have two as good roads as there are in the country. This has been done under the general rates, on account of the two roads being leading thoroughfares, but in the future we may alter this and have our side streets done on the frontage tax plan. One thing however is certain, we are so well satisfied with our experiment that we shall never go back to the old plan of hauling dirt and gravel on our streets.

You will also remember complimenting us on the appearance of our sidewalks in comparison to the state of our roads as they then were. For the last seven or eight years we have entirely discarded the use of laying down wooden sidewalks. A by-law was passed that all sidewalks should be laid on the frontage tax plan, and giving the citizens the power to petition the town council to lay down artificial stone walks instead of the plank walks. This has been availed of to such an extent that we have now over twelve miles of silica-barytic stone sidewalks laid down, and we are adding to it year by year. We have done it on the plan of the town assuming the cost of all crossings and intersections, and in the case of corner lots, the town pays the cost of one-half of the depth of the lot, the property owner paying the rest. This has been done on the principle of twenty year payments divided equally, so that the burden should not come too heavy. So that as you are aware, we are not only adding to the appearance of the town, but I am sure that the durability and the permanent character of the work will result in a large saving in the years to come.

BROCKVILLE.

Brockville has twenty-five miles of streets, 10.65 of which have received a coating of broken stone, hard limestone and granite being plentiful. The work on the streets is performed by day labour under the immediate supervision of an engineer and a street inspector, and directed by a Board of Works. In 1896, \$5,974 was spent on roadwork; \$3,410 on sidewalks; and \$50 on bridges. Respecting the street work, the Mayor, Mr. D. W. Downey, says:—

A portion of our Main Street extending over 2,000 feet was a good deal cut up by the making of numerous water, gas and sewer connections previous to the laying of permanent sidewalks and during next summer we contemplate putting in a better class of roadway on this street, than any we have had hitherto, and hope to profit from the admirable address you delivered here on the subject of "Good Roads".

A very great improvement has taken place in our streets since we obtained the use of a grader, steam road roller and other implements, and considering the great saving of labor thereby, I am often greatly surprised that our adjoining townships have not availed themselves of their use.

As you are aware we only commenced putting down permanent sidewalks during the past summer. These extend to 3,150 lineal feet, covering in all 30,750 superficial feet, at a cost of \$6,200.

NIAGARA FALLS.

The Council did not set apart any but a very small sum for actual street improvement during the year, on account of the construction of the sewers which have been under way; however, they purchased valuable road machinery, including a fifteen ton steam roller and a new grader, and have now in contemplation the purchase of a rock-crusher.

There have been, however, several streets, on which sewers were built last year, which have been macadamized and improved during the past year. The length of street thus improved would not exceed half a mile, but the work which has been done on these has been entirely satisfactory.

We expect next season to go extensively into macadam pavements, and probably some brick on business streets. There are arrangements being made at the present time to provide for the construction of cement or brick walks on an extensive scale, but nothing definite can yet be said in this regard. We have laid none during the past year.

We have obtained a large amount of rock from the sewer construction which is fairly suitable for road metal, though a little soft. This we will have broken during the winter by hand, to give our town people employment.

Whatever work we have had done by our road machinery, has given entire satisfaction and the only thing which now remains to obtain good roads here, is attention to the work by an energetic committee, and the employment of a first-class foreman who understands road construction in its details.

(Signed) CHARLES H. MITCHELL,
Civil & Hydraulic Engineer.

LONDON.

The following extracts from the annual report of the Street Commissioner of London, Ontario, Robt. Ironside, to A. O. Graydon, City Engineer, contain information of an instructive nature:—

Sidewalks. I would recommend that the specifications for walks be amended so as not to allow any planks which now remains to be used as it has been found that the lesser widths contain sap and are therefore not fit for sidewalk purposes.

I would also recommend the appointment of an inspector for this work as it is impossible at present to make a close inspection of the material as it is brought on the work, and should a contractor so desire, it is an easy matter for him to substitute inferior scantling between the visits of the Street Commissioner and the Engineer. The presence of an inspector would be a safeguard against this and other devices contractors are prone to practice in the carrying out of City contracts. The contractors for this work for this year have given general satisfaction and there is little or no complaint about their work or material used, but considering everything, I think an inspector necessary.

As in the past the repair of walks is one of the principal expenditures of this department and while careful supervision has been exercised and repairs made when necessary, yet there are several sidewalks throughout the city that are in a positively dangerous condition and almost beyond repair. In the repairs to sidewalks this year we have used 115,000 feet B. M. of lumber and 8,000 pounds of nails. This includes the material used in relaying old plank saved from old walks that were taken up and replaced with a new walk and relaid in stretches where there were no sidewalks. About 1,200 feet of this class of walk was laid. From the foregoing it will be seen that the "*Plank Sidewalks*" are by no means of a permanent nature and the constant adding each year to our already large mileage of plank sidewalk, together with the annexation of London West, means added increase of expenditure for this work each year; and with a view of keeping down this expenditure, and at the same time putting our sidewalks in an up-to-date condition I would recommend that permanent walks only shall be laid on our principal streets and avenues.

Pavements. The superiority of broken stone roadways over the ordinary gravel roadways is apparent and more of this work should be done each year. There would then be no necessity for scraping off in the spring, the material that was placed there the year previous. I would therefore recommend that less gravel and more broken stone be used in the future, throughout the city; then good roads, not mud roads, would be the rule and not the exception.

The cedar block pavements are, as a rule, in poor condition, some are even beyond repair, and nothing can be done except replacing them by another and better class of pavement.

The asphalt pavement is in fairly good condition, and with the exception of that portion along the street railway tracks, seems to be wearing well. The great objection to this pavement is its slippery condition at times. The cause of this is the too frequent use of the watering cart. Washing down should be substituted as is done in other cities. Washing down thoroughly cleanses the pavement, while on the other hand the moisture of water from the watering cart and the dirt on the pavement renders it dangerous to both drivers and wheelmen, and at the same time destroys the life of the pavement.

A constant source of repairs has been caused by the delivery of material to new buildings and the removal of debris from their site. The teamsters engaged in this work drive over our sidewalks regardless of consequences. The ward foremen have received instructions to make crossings for them but as a general rule the damage is done before their arrival on the scene. I would therefore recommend that a deposit be collected from all who obtain building permits and the amount of damage deducted therefrom.

Culverts and Sewer Repairs. The culverts throughout the city have received the necessary care and attention called for, and every effort has been made to keep them in repair and in a state of cleanliness. The use of the tile pipe in replacing the old wooden culverts is gradually doing away with one of the greatest sources of annoyance and worry to this department. There are several of the present wood culverts and bridges that demand an almost constant supervision, and these should be replaced with structures of a permanent nature without further delay.

Stone Crusher. This machine has, with but few delays, been in operation since May 26th up to December 1st. During that time it has crushed nearly 1,350 cords of stone. The actual crushing time was 110 days, nine hours each, about twelve cords per day.

The cost of the stone, the crushing expenses and the delivery upon the streets, including repairs to crusher, rent of engine, fuel, etc., was about \$5.60 per cord.

This is about \$1.15 per cord cheaper than we can purchase it already broken from the quarries. The crusher has been removed to the storage yard and is now under cover. I would recommend that this machine be overhauled as soon as possible and some of the old parts that are worn out, replaced with new ones so that it will be ready to start operations as soon as possible.

Gas and Water Trenches. There has been little or no improvement in the manner in which gas and water trenches are left by the employees of those departments or companies. No care whatever is taken to preserve the road metal so that it can be replaced again on the surface, but with the utmost carelessness and indifference it was thrown into the trench in any manner, and at times they have been left in a most dangerous condition. Effective means should be taken to stop this practice. There should be no difficulty whatever in refilling in a proper manner such shallow trenches as these, leaving the roadways in as good a condition as formerly.

Sweeping Block Pavements. These pavements have been swept as regularly as the funds would permit, but owing to the unevenness of the surface they are never in a state of cleanliness. The crevices, even after the most thorough sweeping, retain the horse droppings and other filth, and on a warm day, especially after watering carts go over them, the stench arising from them is, to say the least, simply awful. The health of the city requires that steps be taken to replace these pavements, especially in the heart of the city, with asphalt or brick. They are beyond repair, and it is practically impossible to keep them clean.

Street Watering. In concluding this report, I would again call your attention to the manner in which the street watering through the city has been done. Good roads have been built, well rolled with the steam-roller and left hard and smooth, and in a first-class condition. In a short time, owing to the excessive quantity of water put upon them by the contractors for street watering, they have become soft and are easily cut up into ruts.

Unless a change is made in the mode of street watering, money is only thrown away in improving the roads. The street watering inspectors either cannot or will not make the contractors do the work as it should be done, and personally I have repeatedly stopped the drivers of the water-carts from watering mud puddles. If this work was placed under the control of this department and a good foreman and teams employed, I have no hesitation in saying that little or no complaints would be made and the street watering would then be done in such a manner that no injury would be done the roadways, and at the same time satisfy the ratepayers who pay for the work.

ST. CATHARINES.

About \$6,000 is appropriated yearly for repairs, street cleaning, repairs to sidewalks and some small pieces of permanent improvement, under the control of Board of Works and street superintendent.

A street commissioner is employed during the whole year at a salary of \$650. We have this year purchased a grading machine and also a steam road roller and hope to have a stone crusher early next year so that we will be able to follow out Mr. Campbell's instructions.

We have laid this fall about three miles and a half of concrete walk under the local improvement plan which we hope to continue another year.

KINGSTON.

The frontage tax system has been adopted on sewers, and on granolithic and asphalt sidewalks; for sewers in 1885, for walks in 1893.

The City Council Committee, called the Board of Works, has control of all streets and the City Engineer has full oversight. The City Engineer is employed at a salary of \$1500.

The streets are in fairly good order but for the last two or three years the appropriation has been too small and the streets are beginning to run down. We used to get \$25,000 but only get \$10,000 or \$12,000 now and the most of this goes in street cleaning, etc. We were getting up fine macadam streets till the reduction. We have about two and one half miles of granolithic walks, one mile of asphalt and the balance plank. Our chief trouble with our streets is the frequent digging of trenches for sewers, water and gas pipes, and we never can keep a street in proper shape.

NORWICH.

During spring and fall the condition of the streets is bad. Only two main streets are gravelled, and as they lead to railway stations as well as being main roads from the country, the heavy teaming over them cuts them badly. Other streets are only earth roads, graded. About five years ago nearly \$1,000 were spent for gravelling these main streets, and patching has been done since. Most of expenditure for streets has been for sidewalks recently.

Although our rules of council require committees to report in writing stating work completed, location and cost of same before expense is incurred, they do not adhere to that rule. So that because of this lack of system the figures given are approximate, but are probably sufficiently correct to answer your purpose.

Our gravel costs fifty cents per cord, and \$2.50 for drawing and laying—and not very good at that. For the past three or four years we have used a good deal of brick-bats, which we get from the brick yards within two miles of the village. They make a good road and appear to wear well. The past summer about a quarter of a mile of Main street was coated with these and covered with gravel. The bats are, of course, broken with a hammer to about two inches in size.

STAYNER.

The way the work is done by the Commissioner and the manner of paying accounts is such that I cannot give definite answers.

CLINTON.

The general condition of the streets is not good, but since the purchase of the road machine a number of the streets have been graded and made narrower.

COBOURG.

Streets are in better condition than they have been in for some years, some of the gravel roads have been broken up and regraded and are very fine.

AILSA, CRAIG.

The streets were put in excellent permanent repair fifteen to twenty years ago and have only needed patching since that time, with an occasional coat of gravel on the heavily travelled streets.

WINGHAM.

A greater effort has been made this year to improve the streets than formerly. Three miles of Portland cement or granolithic sidewalks are now built. We expect to build a large quantity next year. Had we a stone crusher along with our road machine we would have good streets.

LONDON.

We are using stone and cedar curb and narrowing up streets, and putting down macadam roads as much as possible, using broken stone, underdraining them and rolling with steam roller 12½ (long) tons empty. Plank, asphalt, granolithic and stone are used in the construction of sidewalks.

PICTON.

Money is taken from the general funds of the corporation and expended on roads, walks, bridges and culverts where required "or where the indicator denotes the biggest pull."

We require the appointment of a qualified practical man independent of the bias of the wire pulling always in vogue in councils, to superintend the work on streets, walks, bridges. Such a system would be far better for this, and, I believe, for every municipality; and would be a benefit from a monetary standpoint.

LINDSAY.

Some streets in fair condition, others bad. It is the intention of the council to improve streets in accordance with your ideas.

WATFORD.

Fairly good improvement is being made in the streets. The only special effort was two years ago when we bought forty car loads of gravel from the G. T. R. Co. and had it taken from Komoka gravel pit.

We need more uniformity in our streets, some of the councillors grade too high and narrow and we need a good instructor.

SAULT STE. MARIE.

Streets are not in good condition. None of them that do not cut up in wet weather, though of course their condition is improving every year. It is not the result of any good system though. The worst portions are improved each year, but no systematic attempt.

LAKEFIELD.

About three miles of grading was done in 1896-97, and broken stone was used, the average depth of stone being fifteen to eighteen inches. About 800 yards of stone was also used to fill up a wharf owned by corporation and to grade it uniformly with adjacent street; part was done in December, 1896, the balance in January, 1897.

The roads are first-class; nearly five miles have been covered with stone from the Trent Valley canal during the past two years. Stone or tile culverts has replaced wooden ones, streets graded to uniform level and water tables cleaned and improved. About \$1,000 has been spent in 1897 on roads. Stone was delivered to us free by canal contractor and was broken by contract about six inches deep at 1½ cents per square yard.

Our Road Master is employed by the year and has other duties to attend to for which he receives \$350 per annum.

TILSONBURG.

Steps are being taken to improve the principal street called Broadway street, and the Provincial Instructor's assistance and advice will be asked by the council.

FORT ERIE.

Plank has always been used for sidewalks until this season when granolithic was adopted and about 400 yards laid down. If satisfactory it will be adopted entirely for the future.

EXTRACTS FROM TOWNSHIP REPORTS.

MACHINERY MAY BE PURCHASED.

Adjala, Simcoe Co.—Special effort has been made recently in that gravelling has been started and the purchasing of road machines is under consideration. I believe that if the money could be judiciously expended, and thirty or forty cents a day charged, we would have better roads than under the present system of statute labor.

TILE CULVERTS SATISFACTORY.

Adelaide, Middlesex Co.—Our leading roads are gravelled and are as good as you will find. Culverts are mostly of tile, which give good satisfaction. The tile are manufactured in the municipality.

WOULD LIKE TO COMMUTE.

Ancaster, Wentworth Co.—The council would like to be in a position to commute a part or the whole of the statute labor as deemed advisable.

DOING BETTER WORK.

Arthur, Wellington Co.—The general condition of the roads is fairly good. The county road is good. The most of the roads in the township are fairly well graded and a great deal of gravel is being put on every year by statute labor. The people are getting interested in the matter and are doing better work. It costs the township close on \$300 each year for gravel. They pay six cents per load for statute labor work and ten cents per yard for contract work. This is for gravel alone. Hauling is extra.

BECOMING INTERESTED.

Ameliasburgh, Prince Edward Co.—The roads are in a very good condition ; gravel beds are plentiful in many parts of the township and the inhabitants are becoming interested in the roads and bridges of the municipality.

The doing away with the present system of statute labor and replacing it with a tax on the ratable property of the township, the money to be applied under the supervision of the best available overseer, would be more in the right direction, but public opinion moves slowly, sometimes.

NO SYSTEM.

Albemarle, Bruce Co.—Our roads are very bad ; we have not two miles in the whole township that could be classed as really good. Our roads are constructed without any regard to plan or system, and in consequence the improvement will be slow.

IT WOULD PAY.

Amabel, Bruce Co.—Statute labor as it is worked in our municipality is a complete farce. If the municipal council would only levy twenty-five cents per day (even 25 cents) and appoint a Road Commissioner, it would pay every time.

A STONE CRUSHER.

Bertie, Welland Co.—The road machine is constantly in use during the road-making season. The general condition of the roads is not good. Efforts are now being made to secure a stone crusher.

IN DEBT FOR RAILWAYS \$7,000

Bexley, Victoria Co.—The general condition is not to say bad. Pathmasters draw out every summer gravel where it can be got handy, or do some grading with plows. However, this time of year (fall) the roads appear as bad as though there were no work put on them in the summer. If stone could be utilized, there is any quantity of lime stones close along the roads. I have never seen any of them drawn on the travelled roads and broken up. It is always gravel, or turnpike with the plow. The hammers we got for breaking the tops off the stones striking up too high. The township is \$7,000 in debt to railways and cannot spare much money to lay out on roads. This year (1897) hardly anything has been laid out.

DO NOT GRADE MORE THAN CAN BE GRAVELLED.

Blenheim, Oxford Co.—The grader has been pretty steadily at work in 1896 and 1897. We do not care to grade, however, more than we can gravel, as graded roads become very bad roads in time of rain. The roads are fairly good. The outlay on bridges each year is very heavy. We have two large streams winding through our township causing us to keep up over fifty bridges of large size, besides many small bridges.

SHUT OUT FROM MARKET.

Binbrook, Wentworth Co.—We feel very much the need of a good road metal. The road leading through the township is so bad that we are practically shut out from market with heavy loads. The difficulty of procuring stone makes it almost impossible to better ourselves.

MORE SUBSTANTIAL WORK.

Brudenell, Renfrew Co.—Roads are rough and in a poor condition generally all over the municipality. We have no means to improve them except the statute labor and some small grants by council to repair places that sometimes become dangerous to public travel, and sometimes a colonization grant, but these grants are becoming fewer every year. The main reliance is statute labor, and this, in a great many cases, does not amount to much, and sometimes is done with a great lack of judgment. In my opinion it would be far better to levy a commutation tax at about fifty cents per day and do away with statute labor. There would be more substantial work done.

A ROCK CRUSHER NEEDED.

Burleigh and Anstruther, Peterborough Co.—The statute labor system is bad, but the settlers are too poor to remedy the evil at present. If more broken stone was used it would be better. This country here requires a rock crusher which could be utilized along the main roads on the spot.

THE ROADS WOULD BE BETTER.

Barton, Wentworth Co.—It is the opinion here that roads would be better kept if statute labor by commutation or otherwise were abolished and roads kept in order out of the general funds of the municipality. All stone roads belong to road companies. There is plenty of stone in this township and of good quality.

AN EFFORT TO IMPROVE.

Beckwith, Lanark Co.—Some of the roads are very good and some are very bad, but an effort is being made to improve them by grading and stoning with stone from hammers and stone crushers.

CONSIDERABLE AGITATION.

Brant, Bruce Co.—There has been no special effort to improve the roads other than by county grants which had to be supplemented by an equal amount by the township this year (1897.) Considerable discussion and agitation pro. and con. has taken place regarding better roads. We considered it advisable to place literature on the subject of road-making in the hands of the pathmasters soon after their appointment. This should be done early, say April.

THE TOWNSHIP MAY BUY.

Brighton, Northumberland Co.—The township has not ventured as yet to buy road grading machinery, but it is possible they may do so before long, if from machine work in neighboring township they are thought to be a saving in labor and a better mode of making and repairing roads. Then the township may buy. It is hard to apply statute labor on machines, and the time to force commutation and hire all road work has hardly yet come in this community, although some think this would be a gain.

TALK THE MATTER UP.

Chapman, Parry Sound District.—The roads are in a very bad condition, especially during the months of April, October and November. There are millions of tons of rock (granite and feldspar) in this and adjacent townships. If we had some good man to talk the matter up, the ratepayers who are afraid of higher taxation might demand the purchase of a rock crusher by the Council.

THE RATEPAYERS ADMIT IT.

Charlottetown, Norfolk Co.—The roads are passably good and improving slowly all the time. Most of the roads in this township are sandy roads and very heavy in summer, some parts have been clayed and keep in pretty fair condition. In the vicinity of the gravel beds the roads are improving, but gravel being so scarce very few pathmasters can make use of it. The old way of performing statute labor I consider a fraud, the system is *passee*, much of the labor is wasted under the present system—the ratepayers admit it.

FOR FORTY CENTS A DAY.

Chinguacousy, Peel Co.—The general condition of the roads is first class in dry weather, but bad in spring. Statute labor is a fraud, more work and better roads could be made for forty cents a day.

THIS LAST TWO YEARS.

Carnarvon, Manitoulin District.—The roads are good in dry weather being dirt roads. They cut up in the fall. Our roads are getting better since we have been using the machine this last two years.

SNOW DRIFTS.

Charlottenburg, Glengarry Co.—For some years a good deal has been done to substitute wire fences for timber fences on north and south roads and other roads subject to snow drifts. The effect has been very good not only for winter travel, but also in making a dryer and firmer road in spring and early summer.

IT IS THE NARROW TIRE.

Culross, Bruce Co.—We have pretty fair roads in dry weather. In spring and fall they sometimes get very bad, especially when freezing and thawing. There has been a little more than usual spent on the gravel roads by the county this year. I think that if we could get the wide tire and the unequal axle introduced it would do more to improve our roads than anything we have had yet, or rather save them from destruction, for it is the narrow tire that cuts them up in soft weather.

ONE DRAWBACK.

Colchester North, Essex Co.—There is one great drawback we labor under—that is the failure to get the statute labor performed early in the season so that grading and gravelling has time to settle before our autumn rains.

BY NOT GETTING THE WATER OFF.

Calvin, Nipissing District.—The roads are rutty with steep grades. The pathmasters put in most of their time trying to ditch and crown the roads. Some succeed, more make them worse, if anything, by not getting the water off, still all do the best they know how with what time they have. Twenty miles of these roads have been made by grants from the Government, the Mattawa and Caladar and Shield Pit roads, but there is hardly sufficient statute labor to keep them in repair. Where the ditches carry off the water the roads are passable, (a piece of good and a piece of bad road sandwiched.)

SUPPLEMENTARY LABOR.

Caradoc, Middlesex Co.—The roads are very good. The Council, for the improvement of roads, has adopted the system of supplementary labor, viz., where a road division puts on a certain amount of gravel over and above statute labor, the council supplements the amount. Some are in favor of doing away with statute labor and having the money raised by commutation, say at fifty cents, expended by a road commissioner, while others oppose anything like increased taxation.

A PUBLIC HOLIDAY.

Christie, Parry Sound District.—There is so much rock and swamp in this district that it is and always will be impossible to make good roads, but they can be vastly improved. One of the first steps would be to abolish statute labor which is simply a public holiday.

WATER FOLLOWS THE WHEEL TRACKS.

Cardiff, Haliburton Co.—The roads are in a fearfully bad state all over the township. Water follows the wheel tracks washes out the dirt leaving the stones and boulders for wheels to climb.

IT IS THE PREVAILING OPINION.

Clarke, Durham Co.—The roads are generally good. There is a general improvement made during June and that has to do, unless some part is washed away by floods, and pathmasters have to see that they are repaired. It is the prevailing opinion that the roads are not in as good a condition as they should be considering the amount of statute labor expended or employed thereon and money spent.

EFFORTS HAVE BEEN MADE.

Clarence, Russell Co.—Roads are in a pretty fair state and efforts have been made to improve them still more. We had our road machine rather late last summer and it is expected that more improvements to roads will be made next year.

THE OLD SYSTEM.

Cornwall, Tp., Stormont Co.—The roads are not good, nothing outside of the old system of statute labor is employed.

DISCUSSING ABOLITION.

Derby, Grey Co.—The Council are contemplating the purchasing of improved, up-to-date machinery and are also discussing the abolition of statute labor.

A GREAT IMPROVEMENT.

Dunn, Haldimand Co.—The roads are pretty good. The road grader makes a great improvement on our roads.

SOME LEADING ROADS.

Dummer, Peterboro' Co.—The general condition of the roads is fair, some of the leading roads extra good. Five road divisions are kept up by \$500 road appropriation besides about nearly 700 days statute labor yearly.

THEY SHOULD BE ELECTED.

Dorchester, North, Middlesex Co.—The roads are not very good. There has been \$1,000 expended for gravel on roads that had none on before. The Council of 1897 if elected for 1898, I think, would favor buying a grader.

MORE REAL WORK.

Dumfries, North, Waterloo Co.—It is likely a road machine will be purchased this season and then more real work will be done on the roads.

ABOUT THREE THOUSAND DOLLARS.

Dereham, Oxford Co.—No special effort has been made to improve the roads this year. About \$3,000 per annum is usually expended for the improvement of roads.

BY CONTRACTS.

Downie, Perth Co.—The roads, especially the leading ones, are fairly good, being kept up by township grants and gravel put on by contracts. The other roads are repaired and gravelled by statute labor, while some road beats, which have far to haul, get grants from the Council. We have a large quantity of gravel, some road beats being close to pits, thus the roads can be kept and even made by statute labor; other beats have as far, in some cases, as five miles to draw gravel. What we want in this township, in my opinion, is a stone crusher, but as yet the Council does not see their way clear to buy one.

THE RAILWAY BONUS.

Eldon, Victoria Co.—This township is burdened with a debenture debt incurred in bonusing a railway and until that debt is paid off our Council, fairly representing the feeling of the rate-payers, are averse to expending much money on roads, more than is absolutely necessary to keep them in safe condition.

SHOULD BE COUNCILLORS ONLY

Eramosa, Wellington Co.—No special effort and with yearly statute labor, and usual annual grants, the roads seem to be running down. There seems a general willingness to start out afresh, purchase road machinery, appoint competent road commissioners, etc.

I feel satisfied it would facilitate improvement if Councillors were either debarred from acting as road commissioners, or else only legally acting, when appointed by by-law, the same as any other officer. I think the law is defective; the Council as Councillors only should be elected by popular vote.

PROPER VALUE FOR THE EXPENDITURE.

Easthope North, Perth Co.—The general condition of the roads is "fair to middling," a great deal better than they were fifteen years ago, but not so good as they should be. There is no system of road-making, and consequently there are many different "styles and shapes" of roads. Every pathmaster will have his own way. No special effort made but there is gradual improvement. The whole system of statute labor should be abolished and then, and not till then, will roads assume their proper shape and condition and proper value be gotten for the expenditure made thereon.

GRADING AND GRAVELLING.

Easthope South, Perth Co.—This year (1897) the road grader was used over all the township roads, rounding off the road surface, grading lower parts higher, and the newly graded parts were gravelled.

A QUALIFIED PERSON.

Egremont, Grey Co.—In some localities the roads are fair, according to the skill of the pathmaster ; in others they are simply horrible. No special effort has been made to improve them, and I can see that legislation on this subject is imperatively necessary. I am fully satisfied that if we paid 40 cents a day and had this money expended by a qualified person we would soon have superior roads. I think the general feeling is that way and our present system is now considered a relic of bygone days.

HEAVY LOADS, NARROW TIRES.

Fredericksburgh South, Lennox Co.—The cheese factories open early before the roads become dry ; with heavy loads and narrow tires the roads are badly damaged.

IT SHOULD BE SUFFICIENT.

Glenelg, Grey Co.—The statute labor should be quite sufficient to put the roads in good shape, but many of the pathmasters are very careless in the performance of their duties, and think if they put in their time that is all that is necessary.

A GREATER INTEREST.

Gwillimbury East, York Co.—A greater interest is being taken which will doubtless lead to more systematic action.

THE MACHINE KEPT AT WORK.

Gwillimbury West, Simcoe Co.—The purchase of a road machine at a cost of \$250 was a special effort in 1897. The machine was kept constantly at work for two months.

OUT-OF-DATE.

Goulbourn, Carleton Co.—Every corporation should have two or more road graders, and if the out-of-date statute labor system was done away with and the road graders substituted the change for the better would soon be realized.

AWFUL IN SPRING.

Gosfield North, Essex Co.—There are about ten miles of natural gravel ridge, one of the best roads in the Province. About twenty more are gravelled and in good condition ; the balance are clay roads, fair in continued dry weather, but awful in spring and during a wet fall.

NEED A ROAD TO MARKET.

Gower North, Carleton Co.—Our leading roads some years ago were gravelled, but they have sunk down and become too flat. Since we got our grader we are covering up the old gravel and starting in places to gravel again the next year after grading them. If I might be permitted I would just like to suggest the propriety of the Government amending the Municipal Act in such a way as to make townships lying next to a city give something of a decent road through their territory to the city or market. We are living about twenty-three miles from the City of Ottawa, and I might safely say that about six or seven miles of that road through the Township of Nepean is simply impassable in spring and fall. A very large part of it is in a natural state.

OTHERS DO NOT CARE.

Glanford, Wentworth Co.—Some pathmasters try to keep the road in good condition ; others do not seem to care. I believe the proportion of careless ones is on the increase or has been in recent years.

VERY LITTLE EXPENDED.

Georgina, York Co.—This township has for twenty years (1875 to 1895) been paying a very heavy tax, the result of which was that very little was expended on the highways.

FOR COMMUTATION.

Garafraxa East, Dufferin Co.—The council is going to submit a by-law to the vote of the electors for the commutation of statute labor.

VERY PRIMITIVE.

Glamorgan, Haliburton Co.—Statute labor is nearly all we have to depend on to keep the roads even passable, and the majority of pathmasters' ideas as to roads and the repairing of them are very primitive.

VERY OFTEN DANGEROUS.

Grattan, Renfrew Co.—The greater part of the roads are rough and in the spring and fall they get cut up so that public travel is much impeded and very often dangerous. All that can be done is barely to keep the roads in a sort of repair.

ONE ACRE OF GRAVEL.

Gosfield South, Essex Co.—We have a gravel ridge about one mile long and about sixty rods wide and fifty feet deep of excellent quality. We purchased one acre some fifteen or twenty years ago at a cost of \$300, and we are using it yet.

IN GOOD ROUNDED SHAPE.

Grantham, Lincoln Co.—The roads are nearly all gone over every season with the road machine or large scraper; and I consider the clay roads in good rounded shape.

THE BULLETINS HAD A GOOD EFFECT.

Harvey, Peterboro' Co.—Condition much improved the last two years. The colonization grants from the Government have helped these roads very much for several years past. The little Bulletins which were sent me for distribution in 1896, and which I enclosed in pathmasters' lists, seem to have had a good effect wherever they have been intelligently used by the pathmaster. I would suggest that you cause about fifty copies of the same to be sent for the pathmasters for 1898. It is noticed that the grading, pitch in centre and the width of turnpikes or roadbed is much improved.

STONE CRUSHERS WANTED.

Howland, Manitowlin District.—The council think the Government should give us stone crushers and withhold Government grants to the roads, as stones are plentiful and gravel scarce, and it is the only way to make permanent roads (crushed stone).

WHEN THEY LEARN HOW.

Hallowell, Prince Edward Co.—Our roads in this township are going back and are not so good as they were years ago, but I believe as we learn to use the road machine the roads will improve. Last year we almost spoiled every piece of road we fixed with the machine but this year we have very much improved them. I think we are going to like the machine when we learn how and when to use it, but last fall the people cursed it.

THE PLAN WORKED ADMIRABLY.

Hilton, Algoma District.—The general condition of the roads in this township is good. The municipal council this year handled all commutation moneys and gave out jobs on the different road divisions and inspected the work when completed and found this plan to work admirably. The work was done according to specification and a very much larger amount was done for the same amount of money. Heretofore the pathmasters superintended the laying out of the commutation moneys with very poor results.

RENT THEIR MACHINES.

Hibbert, Perth Co.—The council are employing road scrapers and machines from outside parties to do road work. A considerable amount of road grading was done this year.

ONE MILL ON THE DOLLAR.

Hullett, Huron Co.—One mill on the dollar as a commutation tax payable when other taxes are paid would give us in Hullett about \$2,000 which sum could be expended on the roads in a much more profitable manner than under the present system.

IS IT THE SOIL?

Maidstone, Essex Co.—The general condition of the roads is fair in a favorable season. In spring and fall, however, owing to the nature of the soil, we seldom have good roads. In those seasons even our gravel roads get considerably worked up, and this makes travel over them disagreeable.

THOSE WHO WORK HAVE TO PAY.

Monck, Muskoka District.—In some places statute labor is performed faithfully, and in other places it is not. The council has generally to expend an amount of money equal to fifty per cent. of the statute labor. Statute labor is every year getting more of a farce, and those who work faithfully have to put their hand in their pocket to pay for those who do not work faithfully, causing a great deal of discussion at nominations. Some here think that statute labor is only the relic of the old feudal times as they think they are not working for themselves but for the Queen.

BEGINNING TO SEE IT.

Minto, Wellington Co.—Fairly good, but too much gravel has been put on before the roads were properly graded, the consequence is the roads are too flat on top and retain the water in the spring and fall. I firmly believe a great deal more work would be done, and of a more uniform quality, were the statute labor commuted even as low as sixty cents per day, and many are beginning to see it in the same light.

MORE IMPROVEMENT THIS YEAR.

Medonte, Simcoe Co.—The road machine was kept in use for some time this year and gives satisfaction. More improvement was made in the roads this year than in any previous year, owing to the use made of the machine; and after grading, gravel was applied where needed. Some good substantial pieces of road were made this year.

THIS IS THE SYSTEM.

Monaghan North, Peterborough Co.—The roads are in a fair condition. A very decided effort is on foot to give good roads. We have commuted statute labor at fifty cents per day, and divided the township into three districts, each having a commissioner who supervises all work performed outside of grading which is done by a permanent gang upon the grader, under the foreman who is the operator and directed by the Council. This is working well and in another year, when the people see the results, it will be a great improvement upon the old system.

OWNED BY A PRIVATE PARTY.

Mornington, Perth Co.—There is a road machine owned by a private party in the township and the council employs it for making the roads.

A COMPETENT ENGINEER.

Norwich South, Oxford Co.—Have had a good deal of drainage done under a competent engineer in the past few years, which has a tendency to keep the roads dry, as the water gets away more quickly. In one village, which is incorporated, the road work has been commuted for three years, and the ratepayers find that they get better roads, better jobs, and more work done at a less amount than formerly under the old statute labor.

MORE ATTENTION WILL BE GIVEN.

Nottawasaga, Simcoe Co.—The general condition of the roads is fairly good. Our township is very rough and hilly, and consequently the roads are very hard to maintain, culverts being carried away by freshets, and huge washouts formed on the face of hills. Our roads, notwithstanding, are gradually improving. This is more apparent since the purchase of the grader. There has been no special effort at improvement recently as the township has heretofore been burdened by a railway debt; this being now paid, more attention will be given to roads.

THE ROADS HAVE IMPROVED.

Niagara, Lincoln Co.—The road machine is worked every summer and is very good for grading. The roads have improved since we commenced using it.

ONE-THIRD FASTER.

Oxford East, Oxford Co.—I think statute labor should be done away with, and collect fifty cents per day and let jobs. The road would then improve one-third faster than by statute labor.

POOR, AND GOOD REASON FOR IT.

Pelham, Welland Co.—The roads are poor. Many of them too wide and too flat. When gravel is hauled that which loads the easiest and hence the poorest is taken. The road machine is useful, but there is no uniform system of operating it, each overseer managing it on his own beat. Roads are not, in many cases, put in proper shape before being gravelled. Often they are flat or even hollow in the middle when gravel is dumped in to fill the centre.

CREEK GRAVEL IS BEST.

Plympton, Lambton Co.—Special effort has been made by the purchase and more extensive use of road graders; and more creek gravel used than ever before, as it is found to be very much the best.

LIKE ALL OTHERS.

Pelée Island, Essex Co.—Stoney ridges, with thin stones, one to six inches thick, and any quantity of stone below that, are conveniently situated all over the Island. The west shore has good clean gravel. Pathmasters are like all others—statute labor is a farce. Some pathmasters allow the work to be done late in the fall.

BETTER TO COMMUTE.

Portland, Frontenac Co.—We would like you to give us a talk on road-making. We think that it would be of great benefit to our roads and road-makers. We believe it would be better if it was compulsory to commute the statute labor if at no more than twenty-five cents per day.

THEY WANT GOOD ROADS.

Rawdon, Hastings Co.—The Municipal Council pays for the gravel and thereby encourages the making of permanent roads. Some of our concession lines equal the county gravel roads. Generally speaking nearly every ratepayer wants better roads.

MONEY THROWN AWAY.

Roxborough, Stormont Co.—We need a change in first preparing the roadbed properly and by having good ditches on both sides of the road. Much money has been spent for years, in fact thrown away, owing to this neglect.

SINCE THE AGITATION COMMENCED.

Reach, Ontario Co.—The roads are not first-class, although since the good roads agitation commenced an effort is being made to get our pathmasters to adopt a uniform system, but so far without much success. I am glad the department has sent out this circular, as I believe it will influence councillors to have fuller reports from pathmasters and others engaged in road-making to give statistics which heretofore have not been given in rural municipalities.

ONLY HALF A DOZEN.

Storrington, Frontenac Co.—About sixty-seven pathmasters are appointed, and out of that number perhaps half a dozen know how to make or repair a road. If the statute labor was commuted at forty cents a day and that sum expended by a competent man, I think that the roads would be much better than they now are.

MAY DO IN A NEW COUNTRY.

Sullivan, Grey Co.—The statute labor system does very well in a new country, but it is unsatisfactory and detrimental to good roads in the older townships. There is no definite system in making roads by statute labor, every pathmaster has his own plan—the roads do not show the improvement they should for the amount of labor expended. I am confident if statute labor was commuted at fifty cents for each day's labor and competent men and road machinery employed, more and better work would be performed.

TILE DRAINAGE.

Southwold, Elgin Co.—Grading and gravelling is the order in this township according to the number of miles to be kept in repair. The roads are, in general, good. There is considerable tile drainage along sides of road.

SHOULD HAVE A CRUSHER.

Sydenham, Grey Co.—Our roads are in a poor state, not properly graded. We have very little gravel and find stone broken with the hammer very expensive, and when done not a success, owing to not being able to break it fine enough on top for travel.

MORE WORK IS DONE.

Sarawak, Grey Co.—On two roads, 823 days were commuted at sixty cents per day, and more work is done for sixty cents than for one day's statute labor. All statute labor in older sections should be commuted at fifty cents to sixty cents per day, and road butchering done away with by fifteen butchers for 569 days.

IN THE WAY OF DRAINAGE.

Sombra, Lambton Co.—Considerable improvement has been made in the way of drainage under by-law, a large number of drains being located on the highways throughout the municipality.

THE REPAIR SHOULD BE THOROUGH.

Stephen, Huron Co.—We have as good roads as can be found. I advocated better roads twenty-seven years ago, the result was about fifty miles of gravel road. I had charge of most of the leading roads and although they are fairly good, I could now make improvements on my system. We lay out large sums annually to repair our gravel roads but it is not done to my satisfaction; instead of spreading a certain amount of expenditure over the whole, not adequate to properly repair, I would repair as far as the money would go to make a thorough repair.

GRATIS WORK GIVEN.

Sarnia, Lambton Co.—There has been some extra gravelling done this year and considerable gratis work given.

A SAVING OF GRAVEL.

Turnberry, Huron Co.—Good average of country roads. No special effort has been made except buying a new road machine at a cost of \$235.00 and using it on the roads at a considerable extra cost, but at a considerable saving of gravel. These machines should be highly recommended wherever they could be used. Our council believe they will save their cost in one year in improving the roads.

AN EFFORT MADE.

Tecumseth, Simcoe Co.—Roads in bad condition, but an effort has been made to improve them in purchasing a road machine.

GETTING TOO WISE.

Toronto, Peel Co.—I think the statute labor should be done away with. The people are getting too wise to work faithfully on the roads. I think a commutation of forty cents per day expended by commutation would get a great deal more work done and in a great deal more satisfactory manner.

A GOOD TOWNSHIP OVERSEER.

Thurlow, Hastings Co.—The county has purchased a grading machine which is kindly loaned to aid when a large amount of grading is to be done on a township job. We have a good practical man as road overseer for the township and a very energetic man as county inspector, and I think I can say advisedly that our roads are fairly good.

WELL PLEASED WITH PIPE CULVERTS.

Tuckersmith, Huron Co.—Our roads are said by travellers to be among the best in western Ontario. Some of them are too flat and could be improved by draining. Our main roads are in good condition. Our councils have been very careful of them for a long time. We have commenced this year to use sewer pipe extensively. Have been using some for years and are well pleased with them.

THEY HIRE A MAN.

Thessalon, Algoma District.—All our roads are done by statute labor. We have a road grader and hire a man to run it. It is taken from one road division to another and worked by those using teams to do their statute labor. We could do one-third more work if all the statute labor were commuted.

A RADICAL CHANGE NEEDED.

Tehkummah, Manitoulin District.—I have advocated the doing away of the statute labor system, cut down the commutation tax and purchase a road machine. We need a radical change in our road system. The municipal machinery moves very slowly in the matter. Trust a change will soon take place.

NO AMOUNT ON TOP.

Verulam, Victoria Co.—In those sections where gravel is plentiful and of a good quality the general condition of the roads is very good. In a number of places they lack proper drainage and no amount on the top will make a good road in such cases. In these places the roads are in a very poor condition, being almost impassable. No special effort has been made to improve such roads.

WILL GROW WORSE.

Wallace, Perth Co.—The roads in Wallace are not bad. The grading and gravelling of a central sideroad leading from Listowel to Palmerston since the purchase of the road machine is of great benefit, as the heaviest teaming and greatest traffic is between those towns. The system of pathmasters and statute labor is wretched and will continue to grow worse. A few say twenty of the 105 discharge their duties conscientiously and the others as may be expected, by men who are not paid for their work, and who can not be even reprimanded by the members of a council, who might thereafter suffer from their enmity. A compulsory commutation of even twenty-five cents per day, if judiciously expended, would make such an improvement on our highways as would astonish the natives, *i e.*, supposing statute labor abolished, as it ought to be.

THEY WANT GOOD ROADS.

Williams, East, Middlesex Co.—Our roads in general are excellent. Concession roads, I may say, are all gravelled, and also many of the side roads. Our people are alive to the advantage of good roads, and will not rest contented with poor roads.

SYSTEM NEEDED.

Whitby, Ontario Co.—Better results should accrue from a recognized, continuous system of road repairing, with larger road divisions; or commuting for statute labor whereby longer continuous stretches could be made or repaired in one season, obviating the ordinary patch system and giving continuous good roads on leading lines.

RECEIVING MORE ATTENTION.

Wilmot, Waterloo Co.—A more uniform system of grading is desirable, and since we have the road machine this is receiving more attention. I believe better results would be had if statute labor were abolished and a rate of say fifty cents per diem were charged instead, when road commissioners could be appointed who would carry out a uniform system of grading, draining and gravelling.

EXTRACTS FROM COUNTY REPORTS.

HASTINGS Between 400 and 500 miles of road are maintained exclusively by the county. The County Council appoints a man, during its pleasure, called "the superintendent of gravel roads and county surveyor." He has charge of all gravel roads and county bridges. He devotes all his time to it. Under him are gangs of men each with a foreman. They are employed most of the year and are paid monthly. Over thirty-five years ago, county gravel roads were built and all company roads bought by the county and all roads made free of all tolls.

FRONTENAC. About seven miles of road are maintained exclusively by the county. The County Council appoints an engineer who attends to repairs and keeps the road in an excellent shape.

WELLINGTON. One hundred and forty-eight (148) miles of road are maintained by the county. The roads are managed by commissioners composed of members of the County Council; the roads within each county council division being under control of members of the division. At the January session each year an appropriation of \$50 per mile is granted for maintenance (exclusive of bridges and culverts). Accounts with vouchers are produced at end of year and audited by county auditors. All the foregoing 148 miles have been assumed by the county and purchased from road companies and municipalities. These roads have been owned and maintained by the county for the past thirty-three or thirty-four years. Roads under county management are all macadamized and in first-class state of repair. With the aforesaid annual appropriation they are kept in very good condition.

LENNOX AND ADDINGTON. A number of roads were from time to time assumed by the county, but in January, 1893, the County Council repealed all by-laws assuming county roads. The roads are in a bad condition and rapidly growing worse. No effort has been made by County Council to improve their condition. Good opportunity here for instructor in road-making.

HURON. Some leading roads and all boundary lines are partially maintained by the county.

WENTWORTH. About thirty miles of road are maintained by the county. They are managed by commissioners appointed by the County Council, one road being generally assigned to three commissioners. In 1880, '81, '82 and '83, a net expenditure of about \$16,500 was incurred on two roads of a length of about five miles each, assumed by the county and maintained for some years as toll roads. One of the roads were abandoned in 1891 and the other is now maintained as a free road. The roads maintained by the county are, I believe, in fairly good condition.

VICTORIA. There is much need for improvement. The County Council purchased a stone crusher for the use of such local municipalities as will avail themselves of its use to provide better and well prepared metal. It has already been used in the Town of Lindsay. Mr. Campbell, Provincial Road Commissioner, visited Lindsay in June last and addressed the County Council and the Council of Lindsay. Great interest was aroused and a condition of apparent hopelessness has given place to great hopefulness and determination that hereafter expenditure shall be made under proper supervision according to an approved method.

PETERBOROUGH. In January, 1896, a special committee was appointed by the county council to investigate the system of building and maintaining roads in the County of Hastings, and report with suggestions. This report concludes with the following:

"Having viewed the roads, we are thoroughly convinced that the system of construction and maintenance of roads as adopted by the County of Hastings is good and meets with our approval; and we would recommend, if thought advisable, that this system be adopted by the County of Peterborough.

OXFORD. It has been the custom to appropriate \$3,000 each year to be spent by the reeve or councillor in accordance with the equalized assessment or dividing lines between municipalities. At the June (1897) session of the council a commission was appointed to gain information respecting toll roads with a view to purchase.

ONTARIO. The plan for road improvements has been the construction of three roads through the length of the county. The county is seventy miles in length and eighteen in breadth. One road commences at Lake Ontario and runs through the Townships of Pickering, Uxbridge and Scott, with some slight deviations; another road commences on the Whitby and Port Perry gravel road at Manchester, and runs north through Reach, Brock and Thorah to Beaverton; a third road runs from Oshawa north through Port Perry to Beaverton, following in some places the county line between Ontario and Victoria. There were expenditures on a road connecting the towns of Uxbridge and Epsom, which are on the secondly above mentioned road. There was also a road extending from Beaverton north through the townships of Thorah, Mara and Rama.

Scugog Island, lying to the east of the Township of Reach, was connected to the mainland and very considerable expenditures were made from this roadway down to the foot of Scugog Island. It was only last year that any sum could be obtained for the improvement of the Kingston road passing through Pickering, Whitby Town and Township, East Whitby and Oshawa. This expenditure, as were many of the other expenditures, was obtained upon condition that the local municipalities would make grants of double the amount granted by the county. There are a large number of isolated grants, not connected with any plan of road improvement. The expenditure for bridges on the boundary line between this county and

York, Simcoe and Victoria have been very large indeed, as has also the expenditure upon bridges over the Black, Talbot and branches of the Severn River.

The road across Scugog Lake, three-quarters of a mile, is maintained exclusively by the county, and is managed by a commissioner who makes reports to the county council as to estimated costs of needed repairs, and also makes repairs which are urgently needed under the advice of the reeves of the municipalities between which it lies. This is a roadway across the head of Lake Scugog, with one small bridge, which cost several thousand dollars.

BRANTFORD BOARD OF TRADE.

A report to the City Council on the streets of Brantford was taken up by the Board of Trade, the following memorandum being prepared by a special committee :

Your Committee on City Improvements, to whom was referred the report of Mr. Archibald Campbell, C.E., the Government Roads Commissioner of Ontario, begs to report :

That it views with satisfaction the interest that is now being displayed in this Province, and elsewhere, in the improvement of the public highways, and is convinced that the action of the Ontario Government in creating the office of Roads Commissioner will be productive of very great benefit. In Mr. Campbell, a man eminently well qualified for the important duties with which he is entrusted has evidently been found.

The suggestions that the Roads Commissioner is making from time to time for the betterment of the condition of the thoroughfares of the various municipalities in the Province cannot fail to be productive of valuable results. So far as Brantford is concerned, your committee believes that his recommendations are deserving of most careful consideration by those who are interested in seeing the expenditure upon our public streets made in such a manner as to secure the most permanent results; and at the same time add to the attractiveness of a city of which we are all so proud. Acting upon the authority given us, we have ordered that copies of the report be printed for distribution among the members of the Board of Trade.

It is a source of satisfaction that Mr. Campbell finds so much in Brantford of which he can approve. For our sidewalks, waterworks and sewer systems he has only words of praise, while even in the matter of road-making the concession has been made that more attention has been given to the subject than in the majority of places in Ontario. At the same time, he finds that the system that has been pursued in the past has been faulty, indeed that there has been a want of system, and that there has been a large expenditure of money without adequate results. In this connection, it may be observed that Mr. Campbell probably does the city an unintentional injustice in saying that since its incorporation the sum of \$185,035 has been expended upon its streets, because, prior to 1890, when the local improvement system came into operation, much of the expenditure under this heading was made on sidewalks, bridges, culverts, etc.; this, in addition to the usual expenditure for cleaning, removing snow, etc., from which permanent results are not looked for.

It would be presumptuous on the part of your committee to express an opinion on many of the technical recommendations made by the Roads Commissioner. It is justified, however, in coming to the conclusion, from a purely business standpoint, that it would be the path of wisdom to have our streets permanently made, rather than that considerable sums of money should be annually spent in repair and patchwork without enduring results being obtained. It is certainly deserving of consideration if, in the not distant future, a by-law should not be submitted to the ratepayers, which would provide for the proper construction of some of our principal streets. Whether such permanent work can be done to advantage at the present time is open to question, because so much of the work on our sewers, waterworks, gas service, etc., has still to be done. Had the system been adopted of completing all street connections for such services, as the main work progressed, the proper care of our streets would have been a much easier matter than it is at present. Meantime, as rapidly as circumstances will permit, as much permanent street-making as it is wise to do should be undertaken.

Your committee heartily endorses the recommendation that the city should acquire a steam roller, believing that the experience of other cities has been that proper macadam roads cannot otherwise be made. This is a very important matter, because, in the very nature of things, the great majority of our streets must be made of macadam, and it is desirable that we should have for the purpose the very best appliances. With the roller it would be easy to adopt Mr. Campbell's suggestion that the use of sand and cinders to aid consolidation of the road material be done away with and crushed stone substituted. The results would certainly be more satisfactory, having regard both to the condition of the roadway and the comfort of the citizens. In this connection, it is understood, that the purchase of a rotary screen for the stone-crusher has already been decided upon.

The importance of having established grades for the streets is readily apparent, and uniform grades should as rapidly as possible be adopted.

Without any large additional cost, the appearance of the streets of the city, even as they are at present, would be greatly improved if they were more frequently cleaned than is now done. The proper cleaning of the streets is always an incentive to householders to improve the condition of the lawns and boulevards abutting. Besides, clean streets would give our local wheelmen much less excuse for riding on the sidewalks than they have at the present time.

A matter that is deserving of more serious attention than has yet been given it in Brantford is the proper curbing of all the streets and the laying out of boulevards upon uniform lines. At present, nearly all work that has been done under these headings has been at private expense, which is not only unjust in itself, but there is in consequence a great deal of raggedness and irregularity even on our best residential streets. With the boulevarding once properly made, the public spiritedness of the citizens might fairly be appealed to to maintain it in order. The up-keep of lawns and boulevards would also be facilitated if the hours for lawn watering were made more liberal.

As to the recommendation that the driveway on our streets should be narrowed so as to lessen the cost of construction and maintenance, while at the same time giving greater room for boulevarding there are many things to recommend this course, and so far as our present system of street drainage makes it possible, this plan should be adopted.

Before leaving this subject, your committee would call attention to the statement made by Mr. Campbell, that the funds placed at the disposal of the civic officers entrusted with the maintenance of the city's streets are altogether inadequate for the end in view. For the future it will undoubtedly be necessary to deal with this important department more liberally than has been done in the past.

As to bicycle side-paths, your committee would endorse Mr. Campbell's position, that the best way to please the wheelmen is to improve the general condition of all the city streets, rather than to make narrow paths here and there. There should not be a street in the city upon which a wheel might not be ridden with comfort and with safety.

All of which is respectfully submitted.

REPORT ON THE STREETS OF THE CITY OF GUELPH, ONTARIO.

To His Worship the Mayor and Members of the Council of the City of Guelph:

The importance of well paved streets has not been sufficiently appreciated by the cities and towns of this Province, and it is gratifying to find that Guelph, among other progressive cities and towns, is becoming interested in the matter. Much money has been wasted in many municipalities through ill-advised expenditure arising out of an indifference founded on the idea that the streets are as good as they can be made; that the methods which have held ever since the time of the first settlers are the only methods, and that streets are of little consequence in any case.

Good streets are of prime necessity to the welfare of a city. They are the object of an annual outlay which, if wasted, reacts in a two-fold manner by increasing taxes, and at the same time permitting the evils of bad streets to remain; and it should be understood at the outset that the object of the road and street reform movement is not to urge increased expenditure but to obtain a better use of the money now expended.

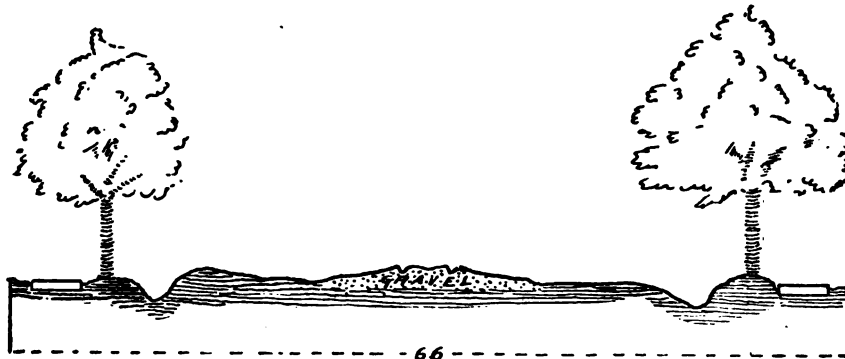
The defects most observable in the street system of Guelph arise from the fact that durable and permanent work is not undertaken; in order to correct which there is need of reforming the present system of street management in two particulars—the method of expenditure, and the method of oversight.

THE EXPENDITURE.

The expenditure should not be distributed over the whole street area in patchwork and repairs, but a reasonable amount should be provided for permanent work. Small sums of five, ten or one hundred dollars quickly eat up an entire yearly appropriation, whereas one-half this appropriation spent in properly macadamizing a few blocks would in a few years revolutionize the condition of the streets in Guelph.

An expenditure to the amount of about \$5,000 annually is divided among the different streets and wards of the city, and this is again subdivided by the ward representative in doing odd jobs here and there. It is not spent in accordance with the needs of the work, but as certain electors think it should be spent. The logical outcome of the system is that this money becomes a legitimate campaign fund; the people expect it and the Council has no other course to pursue. It is the inevitable result of such a system that too much money is provided for one piece of work, and not enough is devoted to another—usually the latter. It is productive of shoddy roadways, and is always wasteful in the end.

Guelph has been making an effort to keep in repair a class of roadways not suited to the traffic over them. They might be considered fairly good township roads. Cheap in first construction, they are expensive to maintain, and after a term of years are very costly. The repairs made to these streets are supposed to be such as will eventually provide a solid roadway; but this method of sinking stone in the mud year by year, and in



Cross-section of a Street under the Old System.

the spring carting off the mud which has been forced to the surface, is an extravagant and useless process, which will not make streets. The waste that arises is of a two-fold nature, combining high taxation and bad streets. It is not to be supposed that streets can be built without money, but when the expenditure is made, as now, it should be to provide good streets.

In order to get the best results in street construction, the work has to be undertaken on a proper scale. A roadway, like a house or any other structure, should be built from the foundation upwards, and should be completed, if only in short sections, before it is used. The roadbed should first be graded, under-drained, and otherwise prepared to receive the gravel, broken stone or other road metal; which last should be placed on the roadway with proper machinery and in accordance with the best principles of road-making. To do this, the expenditure, now extended over a term of years on a badly formed roadway, should be concentrated so as to secure permanent and durable work.

To this end there are three courses open: 1. To set apart a portion of the present annual appropriation. 2. To issue debentures for the amount necessary to do finished work. 3. To adopt the frontage tax system.

OVERSIGHT.

The oversight should be delegated to a competent supervisor, preferably an engineer, instead of being left to the council or a committee of the council.

On business principles there is every reason for placing this work in the hands of one man. Street construction is a matter requiring experience and special training. The plan of leaving it to the councillors is the pathmaster system of the towns. It is even more objectionable in the towns, since the streets demand more skill than do country roads. The supervision of street construction should rest with one who has a knowledge of the subject, together with good business ability.

The engineer would prepare plans and specifications for all work. These having been submitted to, and passed upon by the board of works and council, he would further relieve the council by taking full direction of the work. An engineer is now in the employ of your city for certain purposes, and his duties should be extended to include the management of street improvement and maintenance.

CLASSIFYING THE STREETS.

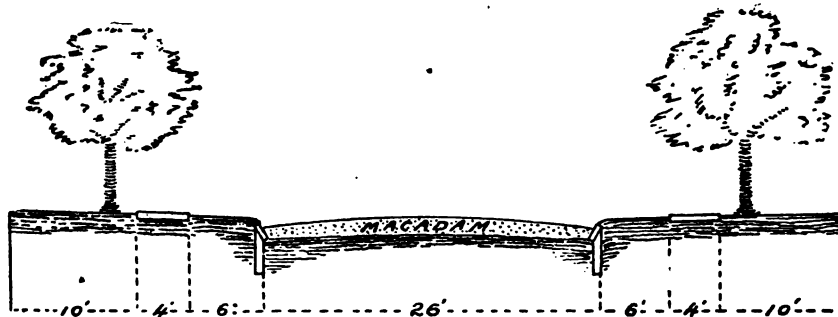
One of the first duties of the engineer in arriving at a plan whereby street improvement may be undertaken systematically would be to classify the streets according to the traffic over them, the character of the street, whether a residential or business thoroughfare, the nature of the soil, grades, etc., with the object of discovering the strength, etc., of roadway required.

It will be seen that such streets as Wyndham, Macdonnell and Quebec, the main business streets, have a large amount of heavy traffic over them to the depot, and that a strong form of pavement is needed.

Another class would evidently include such thoroughfares as Eramosa road, Woolwich street, Paisley street, Gordon and Norfolk streets, over which traffic from the country reaches the centre of the city. That these are residence streets, and that the travel is less severe than on the main streets, should evidently influence the character of the pavement.

A third class would include such streets as are residential, but are not called upon to support either heavy or frequent travel, and the roadway should be built accordingly, at a correspondingly less cost.

By placing before the council such a report upon the streets, showing the present requirements, the probable future requirements, the special improvements in the way of culverts, grading, etc., your council would be in a position to undertake the improvement



A WELL-DESIGNED STREET.

Cross-section showing sidewalks outside the trees and roadway curbed with cedar.

of the city streets on an intelligent basis. At present there is no definite object in view. When permanent improvements are undertaken, much of the work now being done will be found premature or unnecessary, and will be torn up. This is specially true of the grading and the coatings of broken stone and gravel.

There should be definite plans, which successive councils can follow, and toward which all work and expenditure will tend.

CHOICE OF PAVEMENT.

With an abundance of stone easily obtained, broken stone pavements are the most suitable which can be had for heavily travelled streets in Guelph. The excessive width of the street allowances is adverse to the use of vitrified brick or asphalt in the business

sections, as the cost would thereby be much greater than in the majority of towns. For less travelled streets, gravel would be suitable. Macadam roadways are growing in favor in towns. They are pleasant for driving, wheeling, and, if properly constructed and maintained, are handsome in appearance.

EARTHWORK.

The present practice in Guelph is to merely spread the crushed stone over the travelled roadway, without having prepared the subsoil to receive it.

The first step in properly constructing a macadam roadway is for the engineer to take a series of levels on the streets, so that a suitable grade may be decided upon. The width of roadway to be metalled can then be staked out, to be excavated in accordance with the required grade, and to form a receptacle for the stone.

To properly grade and excavate will frequently necessitate the handling of a good deal of earth. This earth should be used as far as possible in levelling the sides of the streets and filling in low lots adjacent to the roadway, disposing of the remainder as circumstances may dictate.

DRAINAGE OF ROADWAYS.

Good drainage is essential for all classes of pavement, and none more than macadam. It must be understood that it is the natural soil which really sustains the weight of traffic, and that broken stone piled on a wet soil cannot be made sufficiently strong to support heavy vehicles, and water permitted to accumulate and stand on the surface of the roadway will cause the pavement to be rapidly churned into ruts and mud.

Underdrainage by means of common field tile is very often necessary. Water falling in the form of rain passes at once through the soil until it reaches a strata of rock, compact clay or other impenetrable layer. If there is an outlet along the strata or rock or clay it will issue in the form of springs. If not, it will rise higher and higher in the soil above the strata through which it cannot pass, just as water poured into a vessel will rise higher and higher until it reaches the top, when it will overflow. Tile drains provide an outlet for this water before it reaches the surface of the soil, and thereby maintain a firmer foundation of earth on which the broken stone may rest. These tile drains should be placed at a depth of about three feet.

Surface draining is provided by rounding up (crowning) the surface of the roadway, thus draining the water to the gutters at the sides of the road, which latter are so graded as to permit the water to flow along them to suitable outlets. Deep ditches are not needed, but the road should be curbed and the angle between the surface of the road and the curb will serve as a sufficient waterway. The surface drainage is further aided by a coating of broken stone or gravel. And it is of prime importance that this coating should be made smooth, hard and compact by rolling so that water will not pass through, thereby softening the earth supporting it.

FOUNDATION.

A firm, unyielding foundation is an absolute necessity for any kind of pavement. This is one of the chief defects in the roadways of Guelph. All road coverings, whether broken stone, asphalt, stone blocks, vitrified bricks, wooden block, form merely a wearing surface. The weight of the load must be borne by the foundation beneath. The natural soil, if kept in a dry state, will support any load. The practice in Guelph appears to have been an effort to cover and fill up wet places by dumping into them loads of broken stone, rather than by removing the water in drains. In this way, the roadways on many of the streets are raised away above the elevation of the sidewalks and adjoining property.

A foundation for a macadam road is obtained by drainage of the roadbed, and thoroughly consolidating it with a roller. In certain cases, especially on clay soils, and

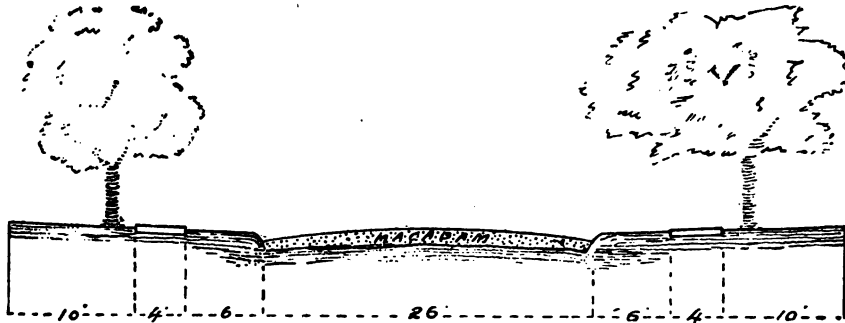
for the most durable class of broken stone roads, a foundation layer of large stones may be placed on edge, the projecting points being chipped off and wedged into the interstices. But for ordinary cases, the layers of crushed stone may be placed directly on the natural earth.

A ROAD ROLLER.

A roller is of first necessity in the construction of macadam roadways. It is needed first to compact the earth on which the broken stone rests. The stone or gravel is then placed in the roadbed in successive layers of about four inches thickness, each layer being consolidated before the next is applied.

The present method is to spread the stone over the roadbed, leaving it for traffic to consolidate. When done in this way the stone is forced down into the soil, and the soil comes to the surface in the form of dust, which has to be carted away every spring. There is no real bond between the stones thus mixed with earth.

But when, by rolling, the subsoil has been thoroughly consolidated and the metal has been placed on the road in a compact coating, each stone of which is wedged firmly, there is a mechanical clasp which will not yield to at all the same degree. The stone



Cross-section of an Improved Street Without Curbing.

covering becomes, under a roller, a roof as well as a floor, and will not permit the water to pass through and soften the earth foundation below; but, being smooth, and properly crowned, the water is at once shed to the gutters.

A CRUSHER.

Stone could be broken to much better advantage for the streets of Guelph by the use of a crusher.

The stone crusher should have a screen attachment whereby the stone could be separated into various grades according to size, the larger stones to be placed in the lower layers of the roadway and the finer on top. The grades frequently are:

- 1st. Such as will pass through a $2\frac{1}{2}$ inch ring.
- 2nd. Such as will pass through a $1\frac{1}{2}$ inch ring.
- 3rd. Such as will pass through a 1 inch ring.
- 4th. Chips and dust screenings.

When stones are laid on the roadway, large and small indiscriminately, the smaller wear more quickly than the larger and a rough surface will result. The larger stones have a tendency to loosen, as their bearing is not so perfect, and they will be found rolling under the feet of horses and under the wheels of vehicles.

A crusher with screen attachment is needed also to properly utilize the gravel of the vicinity of Guelph. It is of very irregular size, ranging from large boulders to sand, and

contains a large amount of clay. One pit on the western side of the town is a complete mass of boulders. By placing a crusher and screen in the pits, and passing the material through, the material would be broken into a suitable size, and the clay and sand would be removed. In dry weather clay and sand assist in making a smooth road, but in wet weather they retain moisture, soften, diminish the strength of the roadway, ruts rapidly appear and the roads "break up." Clean material of proper size is necessary, and, to this end, a crusher with screen attachment should be obtained.

SEWERS.

Sewers have not yet been laid in your city. This is a matter which is closely connected with sanitary conditions and deserves the very serious consideration of your council. That sewers are needed, especially in the central portions of the city, there can be little doubt, and further delay can be but very small economy, if it can in any sense be considered economy. The streets most in need of sewers are those most in need of pavements. It therefore becomes of greatest importance to give these matters early attention.

Sewers should be laid before the streets are paved, since to open a macadamized street to lay sewer pipe causes an injury to the pavement which cannot be easily repaired. Sewers and paving are matters which should be considered together for various reasons, one worthy of mention being that drainage of the roadbed can be very much aided by a sewerage system.

If a sewerage system were designed for the city, and portions laid in the main streets, these could at once be paved. The sewers could then be extended and the paving done concurrently on the lateral or less important streets.

The fact that sewers are needed and that permanent pavements cannot be laid immediately on the main streets does not lay aside the urgent need of a road roller and a rock crusher. There are some streets which will not require sewers for a number of years to come, and these could be properly macadamized at any time. In any case these machines can be used on streets of the kind at present used in Guelph to very great advantage, a plan which has given much satisfaction in Brockville for a number of years, which city possesses a fifteen ton steam roller.

SOME ILLUSTRATIONS.

It may emphasize the foregoing remarks to point out that a large sum of money was spent last year in resurfacing Carden street, but for the want of a crusher to properly break and grade the material, and a roller with which it might be consolidated, the roadway is a practical illustration of the wastefulness of trying to do work without proper implements. Fine gravel and sand were used in covering the stone. This became very smooth during the dry weather, but is being rapidly destroyed in the wet seasons, turning already into mud and ruts.

A grading machine is used in Guelph, but it is almost useless to go to the expense of grading a street without rolling it. By the use of a grader alone a good shape can be given to the road, but when rain comes this loose material is at once saturated, wheels churn it, and the condition of the street is often injured rather than improved. If, after the street is properly shaped by the grader, a heavy roller were used to compact the material a smooth hard surface would be formed. Such a surface would throw the water to the gutters and would make a very serviceable roadway for light travelled streets.

With an immense amount of stone in every part of the city, the large sums of money which have been expended on the streets should, all must agree, have placed them in very much better condition. They are without shape or form and indicate thoughtless, careless management.

IN CONCLUSION.

The City of Guelph bears a royal name, the location is not an accidental one, but was chosen because of its many advantages and the excellence of the surrounding coun-

try. This has evidently been appreciated by your citizens who, in their public buildings, private residences, and the general features of a city, have studied closely the civic welfare. In the matter of streets, which should, under proper management, be converted into park-like stretches, something has been done in the way of narrowing the roadways, laying artificial stone walks, and providing handsome shade trees.

Much, however, remains to be done. While your citizens may feel that the streets are as good as those of many other towns and cities of the Province, the streets of other towns and cities are generally bad. Under the favorable conditions which exist in Guelph the streets should be superior to those of other towns. The people of other towns are becoming aroused to the necessity of improved streets, and there is every probability that this satisfactory feeling of equality will be endangered. The towns of Galt, Stratford, Woodstock, St. Catharines, Niagara Falls and others have purchased steam rollers and crushers, while a number have decided upon the same or equally important steps in the near future.

In the preparation of this report the object has been to outline briefly the essential features of a good system of management. Many important points have received mere mention, while details have been pretty generally avoided. The document will have served its purpose if successful in directing your attention to a very important matter and creating a more lively interest which, if aroused among the citizens as well as in the council, will result in great benefit to your city.

I have the honor to be, gentlemen,

Your obedient servant,

A. W. CAMPBELL,
Provincial Road Commissioner.

DEPARTMENT OF AGRICULTURE, ONTARIO,
22nd day of December, 1897.

EXTRACTS FROM A REPORT TO THE CITY OF St. JOHN, N.B.

STONE BLOCK PAVEMENTS.

Stone block is the oldest of paving materials; is extensively used in cities, and is the strongest and most durable that can be had. It is well adapted to grades up to ten per cent., yields little dust, requires little repair and suits all classes of traffic. It is, however, very noisy and is rather rough. It is therefore not suited to residence streets nor business streets on which there are retail stores and offices. It is best adapted to streets such as Water street, on which there is a large amount of slow, heavy traffic. It should be used also on steep grades in place of asphalt.

The stone generally used is granite or trap. Excessively hard stone wears to a smooth surface and becomes slippery. No examination or test which can be made of stone is perfectly satisfactory in distinguishing the best variety. Different kinds of the same stone and even stone taken from different parts of the same quarry, have different wearing qualities. The trap rocks of Carleton Heights, or the quartz diorites at the end of Sandy Point, will prove satisfactory. Quartzites, of which varieties are found at the west of Lily lake, on the slope of the ridge north of Douglas avenue and on the road to the lake after passing Seely street, are apt to wear away too rapidly. White marble, of which some is found back of Lily lake and elsewhere in the vicinity, is too soft.

The stone blocks should be cut into rectangular blocks about seven inches deep, three inches wide and nine inches long. The price paid for quarrying and making these blocks will average about thirty dollars per thousand. Slabs of a kind which can be handled by one man are split out in the usual manner. These are sub-divided into sections corresponding to the size of the paving blocks, which are then trimmed and finished.

In constructing a stone block pavement the natural earth is first prepared by draining, grading and rolling with a steam roller. On this a layer of concrete is laid, say six or eight inches in thickness, according to the traffic to be supported. On this is spread a layer of sand about one inch in thickness, and in this the stone blocks are embedded.

The blocks are laid stone to stone in courses at right angles to the street line and so that the joints will be broken. A slight variation in the size of the blocks is permissible as regards depth and length, but the width (if three inches as previously specified) should be exact.

On hills and grades a better foothold for horses may be obtained by using rough-finished blocks, or the blocks may be so embedded in the layer of sand on a slight incline in such a way as to present a series of steps. At street intersections the blocks are laid obliquely in what is termed the "herring-bone" fashion so as to give a secure foothold to horses turning the corners. The joints between the blocks are filled with sand and tar cement.

The State of Maine, adjoining New Brunswick, is one of the largest producers of stone paving blocks.

ASPHALT.

The materials of which asphalt pavements are composed may be either natural or artificial. Natural asphalt is obtained by grinding to powder bituminous limestones found in Texas, Utah and elsewhere, or the bituminous sandstones found in California, Kentucky, Texas, etc. This powder is then heated until soft and it spread while hot on the roadway. The chief source of artificial asphalt is the Island of Trinidad, W. I., where crude asphaltum is obtained, is then refined and mixed with sand and stone dust; is heated and applied to the roadway.

Owing to the skilled labor and machinery needed in laying this pavement it is, in the great majority of cases, laid and kept in repair by contract. When properly laid its durability cannot be questioned, but there is some difficulty in surrounding a contract with such safeguards as will ensure first-class material and workmanship. A reliable company should be employed and the maintenance of the pavement guaranteed for ten or fifteen years. A common guarantee is for a term of five years, but this is not sufficient. Breaks in asphalt pavement must be immediately repaired, otherwise they quickly shear off under wheels, and the size of the hole increases with great rapidity.

On the business streets of St. John, where the traffic is severe, where noise is objectionable, and where smoothness, cleanness, ease of travelling, are desirable, stone blocks are not suitable. Asphalt is the most durable material filling these conditions. It is not, however, suitable for steep grades, and stone blocks would necessarily be retained for grades greater than three per cent. Nor should asphalt be used between and adjacent to street car tracks. The gutters, too, should be formed of concrete or flagstone, as asphalt decays rapidly from the effect of moisture.

VITRIFIED BRICK.

Vitrified bricks for street paving are different in composition and manufacture from the ordinary building brick. They are made from shale, or clay, or a mixture of the two, which is heated to the point of vitrification and then slowly and gradually cooled. The size of each brick is about $2\frac{1}{2} \times 4 \times 8\frac{1}{2}$ inches. They are laid in the same manner as stone blocks, viz., in courses at right angles to the direction of the street, with broken joints, etc. The durability is not equal to that of asphalt or stone blocks. But they are less noisy than stone blocks. The pavement is adapted to business or residential streets on which the qualities, but not the strength, of asphalt are required. They are manufactured in the Province of Ontario, in the States of Ohio, New York, and Pennsylvania and elsewhere. There is room for much variation in the quality of brick. The process of manufacture is one which requires an expensive plant and much skill in burning. The

composition of clay or shale used is of great importance. It may contain, for example, too much lime, which will destroy the brick on exposure to moisture. Care must therefore be taken in selecting the brick to be used.

WOOD PAVEMENTS.

Cedar blocks and pine pavements have been used in St. John to some extent. In Canada and the United States wooden pavements are very much in disrepute. They have been found to decay rapidly, settle unevenly, become rough and unsanitary, absorbing filth and giving off bad odors. Much of this is unquestionably due to the methods of constructing these wooden pavements in this country.

In England and France they are regarded with favor, but the timber used there is carefully selected, so as to exclude any blocks showing signs of decay. Oblong blocks are cut all of equal size. They are treated with creosote, tar, and other preservatives, and are laid on concrete foundations. Some soft woods are used, and the life of such pavements is about ten years. The best wooden pavements are made, however, from Australian hardwoods, particularly the jarrah, karri and other of the eucalyptus woods of South Australia.

In the absence of actual experience in this climate with wooden pavements constructed in the careful manner outlined in the foregoing paragraph, their use cannot be recommended. Certainly cedar block and pine pavements as commonly laid in this country are not a success and should not be tolerated.

COST OF PAVEMENTS.

In the matter of cost most pavements, including macadam, require pretty much the same expenditure up to a certain point—the completion of the grading, under-drainage, curbing and excavating, preparatory to receiving the paving materials. Up to the layer of concrete the cost, excluding macadam (that is for asphalt, stone block, vitrified brick and wood pavements), is very much the same, but may vary according to the depth of concrete used and the material for curbing, whether stone or wood. As I have no data for calculating the amount of grading, excavating and drainage needed in St. John, it becomes impossible for me to make an estimate of the cost of the work applicable solely to your city.

The following indicates the basis for a strong form of pavement, on which the cost of a macadam roadway twenty-seven feet wide, for a resident street, may be estimated per lineal feet :

Excavating and grading roadway	\$0 30
Grading boulevard	6
Water and sprinkling	4
Rolling	10
Crushed stone in the street at \$1 per cubic yard	1 00
Drainage	10
<hr/>	
Total per lineal foot of street	\$1 60
Total per square yard	0 53½

With cedar curbing, 4 x 12, the cost would be \$1.72 per lineal foot or 57½ cents per square yard ; with stone curbing, \$2.80 per lineal foot or 86½ cents per square yard.

In estimating the cost of an asphalt pavement to replace the cedar block on such a street as Main street, with a roadway forty feet wide, the actual cost would be about as follows :

Removal of cedar blocks and excavation per lineal foot.....	\$0 44 4-9
Drainage per lineal foot	15
Concrete, six inch layer, per lineal foot.....	2 22 2-9
Asphalt surface, per lineal foot	4 44 4-9
Total per lineal foot.....	\$7 26 1-9
Total per square yard	1 63 $\frac{3}{4}$

The maintenance is usually estimated on a basis of eight cents per square yard per annum. The cost, therefore, for a five years' guarantee is 40 cents; ten years, 80 cents; fifteen years, \$1.20. The total cost then under a five years' guarantee is \$2.03 $\frac{3}{4}$; under a ten years' guarantee, \$2.43 $\frac{3}{4}$; under a fifteen years' guarantee, \$2.83 $\frac{3}{4}$. In the above estimate the profit of the contractor on initial construction is not included and is regulated by competition.

Asphalt pavements, as previously stated, are laid by contract. This material is one which can be greatly adulterated and it will usually be advisable to have the work done by a reliable company under a long term guarantee. Recent inquiry shows that Ottawa has had rock asphalt pavements laid, with maintenance guaranteed for fifteen years, for \$3.10 per square yard; Montreal has had rock asphalt pavement laid, guaranteed for a similar term, for \$3.09. Trinidad asphalt, maintenance guaranteed for ten years, has cost in Montreal \$3 43 per square yard; Toronto, \$2.60; in Hamilton, \$2.15. Montreal paid \$2.85 for Trinidad asphalt on a five years' guarantee. The apparent disparity in these prices may be accounted for in part by differences in specifications regarding drainage, concrete foundations, and as regards special work on gutters, curbing, etc.

For a roadway of the same description as that on which the cost for broken stone was computed, twenty-seven feet wide, an estimate for brick pavement would be as follows:

Excavation and grading roadway, per lineal foot.....	\$0 30
Grading boulevard.....	6
Concrete, six inch layer.....	1 50
Drainage.....	10
Brick surface laid	3 45
Total per lineal foot	\$5 41
Total per square yard	1 80 $\frac{1}{2}$

The following is an estimate of the actual cost of laying one square yard of stone block pavement, on a basis of the whole of the work being performed by the city. Labor on street railway allowances would be slightly more expensive:

Stone in quarry	\$0 10
Quarrying stone.....	25
Making blocks.	1 20
Hauling	10
Laying and grouting.....	75
Removal of old pavement, excavation, grading, etc.....	13
Drainage.....	5
Concrete, eight inch layer.....	67
Sand coating	5
Total per square yard	\$3 30

THE FRONTAGE TAX SYSTEM.

In connection with the frontage tax system, inquiry is frequently received respecting the form of by-laws necessary. The following by-law of Blenheim, Kent county, a town having about 2,000 population, appears to be very complete, and should serve as an excellent basis for other places adopting this system :

Whereas it is deemed desirable to provide for certain improvements, works and services being paid by special assessment on the property benefitted :

Be it therefore enacted by the municipal council of the corporation of the Town of Blenheim, in the County of Kent, as follows :

1. This by-law may be known and cited as "*A By-law respecting Local Improvements and special assessments therefor.*"

2. Unless the context otherwise requires, the following words and expressions in this by-law shall have the meaning hereby assigned to them respectively, that is to say :

The words "local improvement," "work," or "service" shall mean any improvement, work or service, the cost of which may be charged by the council under any of the provisions of "The Municipal Act of Ontario" against the real property immediately benefitted, by way of special assessment.

The word "owner" shall be construed and deemed to include a leaseholder, the unexpired term of whose lease (including any renewals therein provided for) extends over a period which is not less than the duration of the proposed assessment, if the lessee has covenanted in his lease to pay all municipal taxes on the demised property during the term of said lease, and would be liable for the taxes for the proposed improvement.

The word "Inspector" shall mean such person as may be appointed Inspector of Public Works by the Municipal Council of the Town of Blenheim.

The words "Engineer," "Clerk," "Treasurer" and "Board of Works" shall mean "Engineer," "Clerk," "Treasurer" and "Board of Works" of the Town of Blenheim.

The word "corporation" shall mean "The Municipal Corporation of the Town of Blenheim."

The word "council" shall mean "The Municipal Council of the Town of Blenheim."

3. From and after the first day of May, A.D. 1895, all future expenditure in the Town of Blenheim for the several classes of works, improvements and services herein-after mentioned, for which (amongst others) special provisions are made in section 612 of "The Consolidated Municipal Act of 1892," that is to say :

A. Making, enlarging or prolonging any common sewer.

B. Opening, widening, prolonging or altering, macadamizing, grading, levelling, paving or planking any street, lane, alley, public way or place, or constructing any sidewalk.

C. Curbing, sodding or planting any street, lane, alley, square or public place.

D. Re-constructing, as well as constructing, any of the said works or improvements shall be by special assessment on the property benefitted and not exempt by law from assessment.

4. In the opening, widening, straightening or extension of streets, where the whole cost of the improvement is assessable against the property fronting or abutting upon the street or portion of street to be opened, widened, straightened or extended, the owners of the land to be taken for such opening, widening, straightening or extension must dedicate the same to the town free of cost, and no such street shall be opened, widened, straightened or extended unless the land required therefor has been so dedicated to the town free of cost, notwithstanding the fact of a petition sufficiently signed having been presented for the said improvement ; provided this prohibition shall not apply in any case as to which three-fourths of the members of the council present at any meeting thereof

shall vote that it is in the public interest that the street should be opened, widened, straightened or extended at the expense of the properties abutting thereon, notwithstanding the refusal of the owners of the property required therefor, or of some of them, to dedicate the property so required.

5. In making every assessment to defray the cost of the construction of pavements, sidewalks and sewers, the Engineer shall make an allowance on corner, triangular and other irregularly shaped pieces of land situate at the intersection or junction of streets, as follows :

On lots having an angle of ninety degrees, an allowance of one-third the number of feet on the side of the lot to be assessed ; on lots having an angle of more than ninety degrees, an allowance of less than one-third the number of feet on the side of the lot to be assessed ; on lots having an angle of less than ninety degrees, an allowance of more than one-third the number of feet on the side of the lot to be assessed, as may in each case, in his opinion, be deemed just and equitable, having due regard to the situation, value and superficial area of such lot, as compared with adjoining lots and pieces of land assessable for such improvements, works and services.

6. Any allowance made in pursuance of the next preceding section may be charged on the real property fronting on the improvements, or be assessed as a portion of the town's share of the costs of such improvements, in like manner as the intersection of streets, or partly on both, in such proportions as may be deemed just and equitable by the Engineer, and the cost of any portion assessed against the town shall be provided in like manner as in the case of street intersections.

6A. In every assessment to defray the cost of the construction of pavements, sidewalks, and sewers, where the said improvement fronts upon lands which are by law exempt from taxation for the said purposes, the amount necessary to construct that portion of the said improvement fronting upon the lands so exempt as aforesaid may be charged on the other real property fronting on the improvement, or be assessed as the town's share of the cost of such improvement in like manner as the intersection of streets or partly on both, in such proportions as may be deemed just and equitable by the Engineer, and the cost of any portion assessed against the town shall be provided in like manner as in the case of street intersections.

7. Any allowance or assessment made in pursuance of the last two preceding sections shall be subject to appeal to the Court of Revision, and from the Court of Revision to the County Judge, as hereinafter provided.

8. In the construction of any granolithic, stone, asphalt or brick sidewalk the municipality shall assume forty per cent. of the cost thereof, in addition to any other portion which may be assumed by or assessed against the municipality, and the said forty per cent. shall be added to that portion of the cost of the construction of said sidewalk to be provided by the municipality, as in the case of street intersections.

9. All matters of small pieces of sidewalks and other improvements, the cost of which can be estimated and reported upon by the Inspector, shall be referred to him, and shall be reported upon by him, in the same manner as if referred to the Engineer, and in such cases the word Inspector shall be taken as meant Engineer.

10. All costs incurred in carrying out the construction of any improvement, work or service, other than the construction itself, the overseeing of the same and providing the necessary funds, shall be borne by the municipality, and may be provided in the same manner as in the case of street intersections, or charged to the general fund, as the council may by resolution determine.

11. No work or improvement for which it is proposed to assess the real property immediately benefitted, as for a local improvement, shall be undertaken by the council unless and until the provisions of this by-law shall have first been complied with.

12. All petitions for local improvements, works or services to be made, done and performed under the provisions of this by-law, shall, as soon as received by the Clerk, be examined by him, and it shall be his duty to ascertain and finally determine whether the

same are signed by two-thirds in number of the owners, representing at least one-half in value, exclusive of the value of improvements, of the lands benefitted, according to the last revised assessment roll of the municipality, and liable to special assessment for the proposed improvements, works or services, and such petitions when found to be correct, as aforesaid, shall be numbered by him in the order they are received, and be entered at length in a book to be kept for that purpose, to be called the "Local Improvement Book," and the Clerk shall endorse upon such petition his certificate of the correctness thereof, and of the value of the whole of the real property (exclusive of improvements aforesaid) rateable for the proposed improvement, work or service, and shall forthwith so transmit the same to the Engineer. In case the petitions shall be found to be insufficiently signed, they shall be so certified by the said Clerk, and forwarded in like manner to the Engineer for his consideration.

13. Upon receipt of any such petition the Engineer shall forthwith examine into the subject matter of the petition, and report with as little delay as possible upon the necessity for, or the advisability of, undertaking the proposed improvement, work or service, and the reasons therefor, and particularly whether in the case of drains and sewers the same are desirable or necessary for sanitary or drainage purposes.

14. In the event of the Engineer reporting in favor of the undertaking of any such improvement, work or service, he shall also, after due and proper examination and inspection, report :—

A. What real property will be immediately benefitted by the proposed improvement, work or service, and the measurement of the frontages liable to the rates, and those exempt from taxation ;

B. The probable lifetime of the improvement or work ;

C. An estimate of the probable cost of the proposed improvement, work or service, and the amount thereof, which shall be assessed against the property to be immediately benefitted ;

D. The proportion in which the assessment is to be made on the various portions of real property so benefitted.

15. In the event of the adoption by the council of the report of the Engineer recommending the undertaking of any such improvements, work or service, it shall be the duty of the clerk to give all necessary notices to property owners as hereinafter provided and as provided by the statute in that respect, and make all necessary special assessments on such property immediately benefitted as aforesaid, pursuant to the statutes.

16. In any case when the engineer or board of works shall have recommended the undertaking of any improvement work, or service as a local improvement, and shall have recommended that the cost thereof shall be assessed against the real property immediately benefitted, although there be no petition therefor, or the petition therefor shall not have been sufficiently signed, and in any case when the said engineer or board of works shall have recommended the construction of any works, or the making of any improvement for sanitary or drainage purposes, the engineer shall, after due and proper examination and inspection, ascertain, determine and report, as hereinbefore set forth, and make the necessary assessment, and when such report and assessment has been approved of and accepted by the council, it shall be the duty of the clerk :

A. To cause a notice of the intention of the said council to undertake such proposed work, improvement or service, and to make such proposed special assessment, to be given in a public newspaper published in the Town of Blenheim, once in each week for two successive weeks, and the said notice shall state generally the nature of the proposed improvement, work or service, the estimated cost thereof, the property reported by the engineer as immediately benefitted, and estimated amount to be charged as a special assessment against the lands immediately benefitted, and that unless a petition against the proposed improvement, work or service and the proposed special assessment, signed by a majority of the property owners, representing at least one-half in value of the real property proposed to be assessed, according to the last revised assessment roll, be presented

to the council within one month from the last publication of the said notice, the proposed improvement, work or service will be undertaken, and the special assessment therefor will be made by the council.

17. In the event of a petition being presented to the council against any proposed improvement, work or service, and a special assessment therefor, within the time limited by the notice, the Clerk shall report to the council whether the same is sufficiently signed by a majority of the owners of the real property proposed to be assessed, representing at least one-half in value of said property, according to the last revised Assessment Roll.

18. In the event of no petition, or no petition sufficiently signed, being presented within the prescribed time, the clerk shall forthwith cause a notice at least fifteen days before the day appointed for the sitting of the Court of Revision, to be given or mailed to the owners and lessees or agents of such owners and lessees having a right to petition, of the real property mentioned in the report of the engineer as being immediately benefitted, in the form of Schedule "A" hereunto annexed, stating the time and place of meeting of the Court of Revision for the hearing of appeals, and ten days notice shall also be given in some newspaper published within the municipality, of the time and place of meeting of the said court, which notice shall specify generally what is the nature of the improvement, work or service, and what property is proposed to be specially assessed as immediately benefitted, and the time and manner in which the same is payable, and the said notice may be in the form "B" hereunto annexed.

19. The engineer, clerk and solicitor shall attend the meetings of the Court of Revision, and the said court shall sit at the time and place given in the notices given as aforesaid, and shall hear and determine all appeals which may be brought before it, pursuant to the provisions of the statute in that behalf.

20. In the event of any property owner appealing from the Court of Revision to the Judge of the County Court, the clerk shall proceed forthwith to procure an appointment from the Judge for the hearing and disposal of the appeal.

21. In the event of no appeals from the Court of Revision, or so soon as any such appeals shall have been disposed of by the judge, the clerk shall forward a certified copy of the report of the engineer, with any alterations or amendments which shall have been made by said Court of Revision or judge to the council.

22. Upon the receipt of such report as last before provided, it shall be the duty of the board of works to call for tenders for the construction, making or doing of the proposed work, improvement or service, and report the result to the council, recommending the awarding of the contract, or recommending the carrying on of the work by the inspector or engineer or under his supervision, and asking that funds may be provided for carrying on the work to completion.

23. In the event of the council adopting the report of the board of works awarding any such contract for any such local improvement, work or service, or the doing of any such work by the inspector or engineer, the mayor and treasurer shall make such arrangements with banks or other persons or bodies corporate, pursuant to the provisions of the statute in that behalf, as may be necessary to provide the amount of money required to carry on such local improvement, work or service, to completion, in anticipation of the special assessment therefor, and no such contract or agreement shall be executed, or work proceeded with, until such financial arrangements shall have been made.

24. The engineer, upon receipt of notice that a contract has been awarded, and the necessary financial arrangements therefor have been made, shall forward the specifications, plans, drawings and all other proper and necessary material, together with the accepted tender, to the town solicitor, who shall, with as little delay as possible, prepare the necessary contract and bond of security.

25. Upon the contract or agreement being duly executed, and not until then, the board of works may authorize the improvement, work or service to be proceeded with, and carried to completion.

26. After the completion of any such improvement, work or service, and after the entire cost thereof, including compensation for damages (if any) shall have been ascer-

tained, the engineer shall certify the total amount thereof to the treasurer, showing by such certificate what amount is chargeable to the property benefitted, and what amount is chargeable to the town at large.

27. The treasurer shall, as soon as possible after the receipt of the report of the engineer, under the last preceding section, ascertain the amount properly chargeable for interest on the advances made, and the estimated interest which will accrue thereon until the necessary assessment shall have been made, the necessary by-law passed, and the debentures to be issued thereunder shall have been disposed of, and moneys provided to retire the temporary loan, and certify the same, together with the amount shown by the engineer's report distributed as before provided, to the council.

28. Upon the adoption of the last mentioned report the council shall, with as little delay as possible, proceed to make the necessary special assessment upon the property immediately benefitted, and upon all other assessable persons, bodies corporate and property, pursuant to the provisions of the statute in that behalf.

29. The engineer, treasurer and clerk shall furnish the solicitor with all statements, calculations and other information, as may be required by him to enable him to prepare the necessary by-law, providing for levying and collecting such special assessments, and for borrowing money by the issue and sale of debentures.

30. Any person whose property has been assessed for any improvement, work or service, under the provisions of this by-law, may pay the amount of such assessment, less the interest, at any time before the preparation of the debentures, in which case the amount of debentures shall be proportionately reduced.

31. When a by-law shall have been passed, making the construction and maintenance of works and improvements at the intersection of streets and opposite properties exempt from local rates, the subject of a general rate or charge, the exemption from general rates shall not extend to the item included in the by-law respecting yearly rates to meet the expense of such improvements and works opposite such exempt properties and at the intersection of streets.

32. In cases where the improvements or works are provided for by section 612 of "The Municipal Act," no real property or any owner thereof shall be entitled to the benefits of the provisions of the said Act and of this by-law in respect to exemption from any general rate during the year in which the by-law providing for any local improvement shall have been passed; and where any by-law for a local improvement provides for the issue of debentures, such debentures shall not be issued before the 30th day of December next after the passage of such by-law; and no special rate shall be collected in respect of any such by-law during the year in which the same shall have been passed.

33. This by-law shall come into force and take effect on, from and after the final passing thereof.

Finally passed, signed and sealed in open council this eleventh day of March, 1895.

JOHN W. GIBSON,
Clerk.

JOHN F. TITUS,
Mayor.

FORM A.

To

You are hereby notified that the Council of the Corporation of the Town of Blenheim proposes to pass a By-law providing for the
The total cost of the said improvement as estimated by the
is the sum of \$ and the said improvement is proposed to be carried on as a
local improvement, and be paid for by special assessment on the real property immediately
benefitted, as the same appears by the report of the
dated the day of 18 on file in the Clerk's office.
Your real property, which will be immediately benefitted by the said proposed improve-
ment, consists of feet frontage on the side of said
 upon which it is proposed to charge an equal proportionate part of the
cost of the said improvement, having regard for the whole assessable frontage on said
 , the same to form a special assessment upon your said lands,
according to the frontage thereof, and be payable in equal annual
payments, at the same time as your general municipal taxes, such payments to be suffi-
cient to cover annual interest and form a sinking fund for the principal sum or debt
incurred for said improvement. The Court of Revision will sit for the confirmation of
the Overseer's or Engineer's report upon the lands assessable and in which said special
assessments are to be made, for the said improvement, at the Town Hall, on day
the day of A.D. 18 at the hour of o'clock
in the noon, at which time and place all appeals against the same will be heard.

I am, your obedient servant,

FORM B.

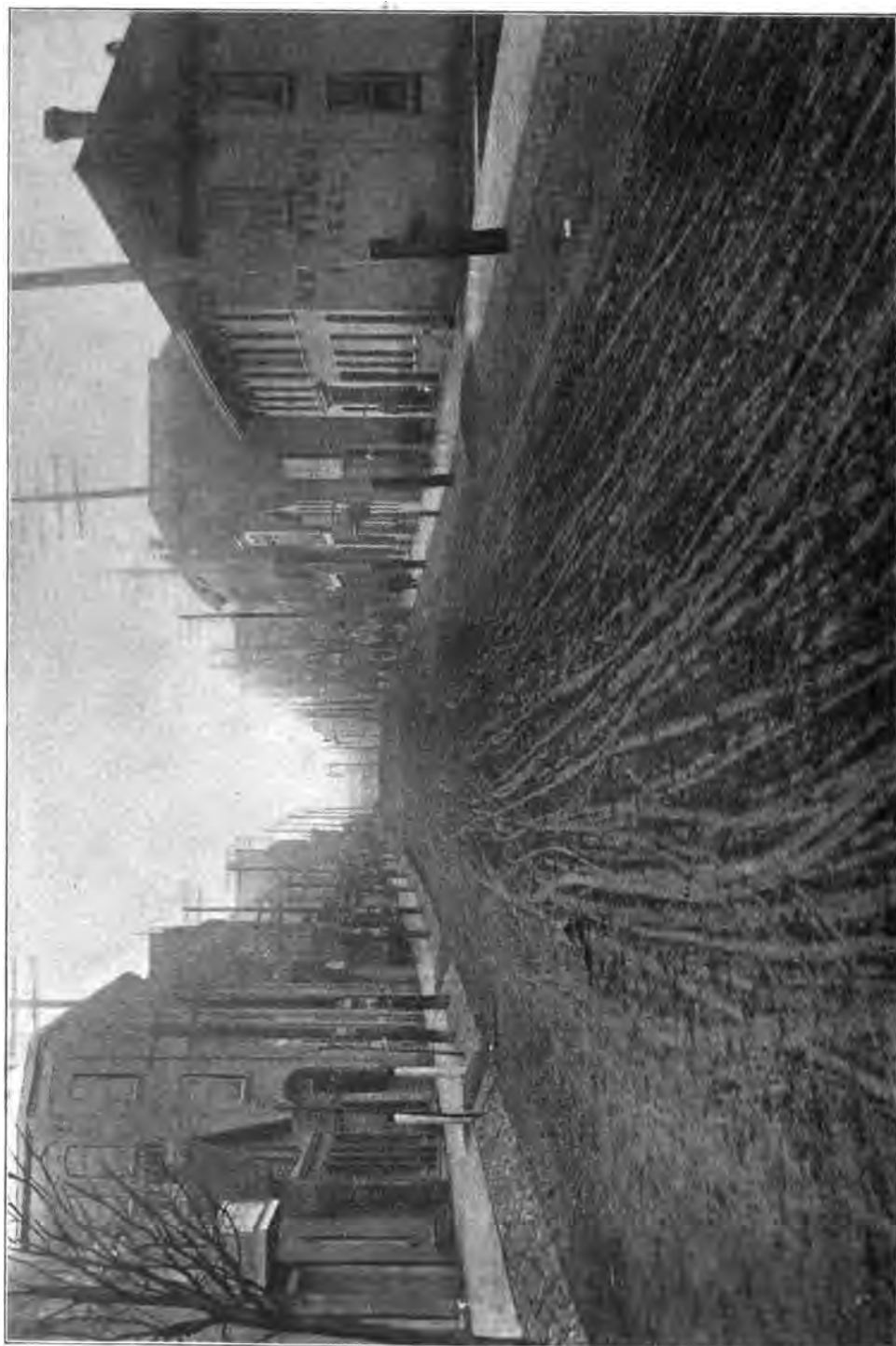
Public notice is hereby given of the sitting of the Court of Revision at the Town
Hall, Blenheim, on day, the day of A.D. 18 , at the
hour of o'clock in the noon, for the hearing of appeals, pursuant to
the Statutes in that behalf, respecting the proposed
and the special assessment of the cost thereof upon the lands immediately benefitted, pur-
suant to the report of the Overseer or Engineer, dated the day of
 18 .

The estimated cost of the said improvement is \$ payable in
equal annual instalments, sufficient to cover interest at the rate of per
centum, per annum, and a sinking fund for the payment of the said principal sum, and
the lands proposed to be especially assessed therefor consist of

Dated at Blenheim, this day of 18 .



THAMES STREET, INGERSOLL : MACADAMIZED IN 1897.



A MACADAMIZED STREET IN INGERSOLL.



A STRATFORD STREET PAVED IN 1897.

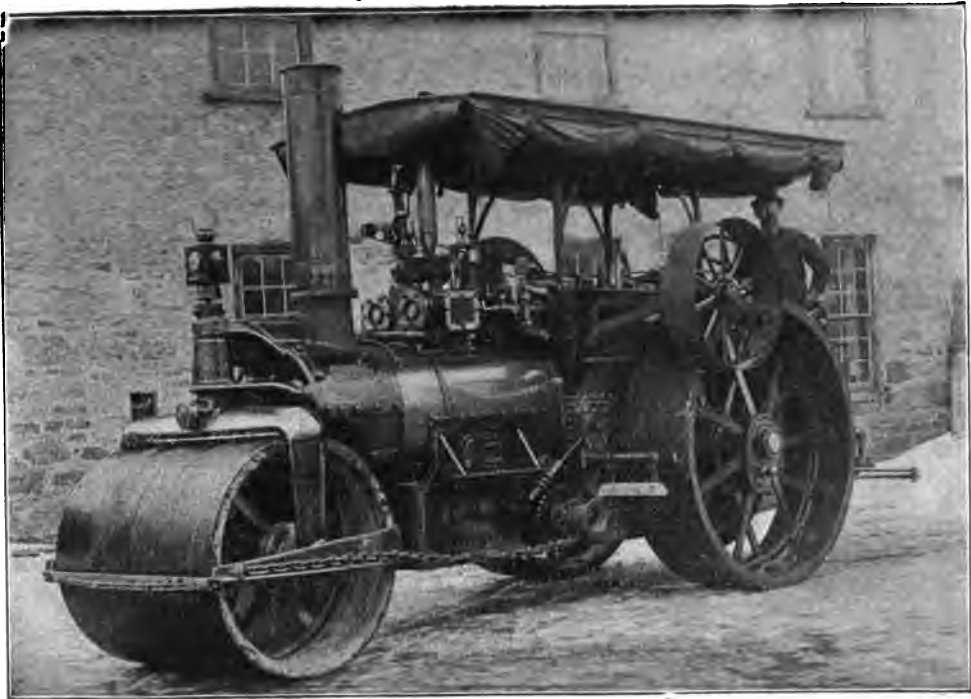


A STRATFORD STREET.

There is a decided contrast where improved and unimproved sections meet.



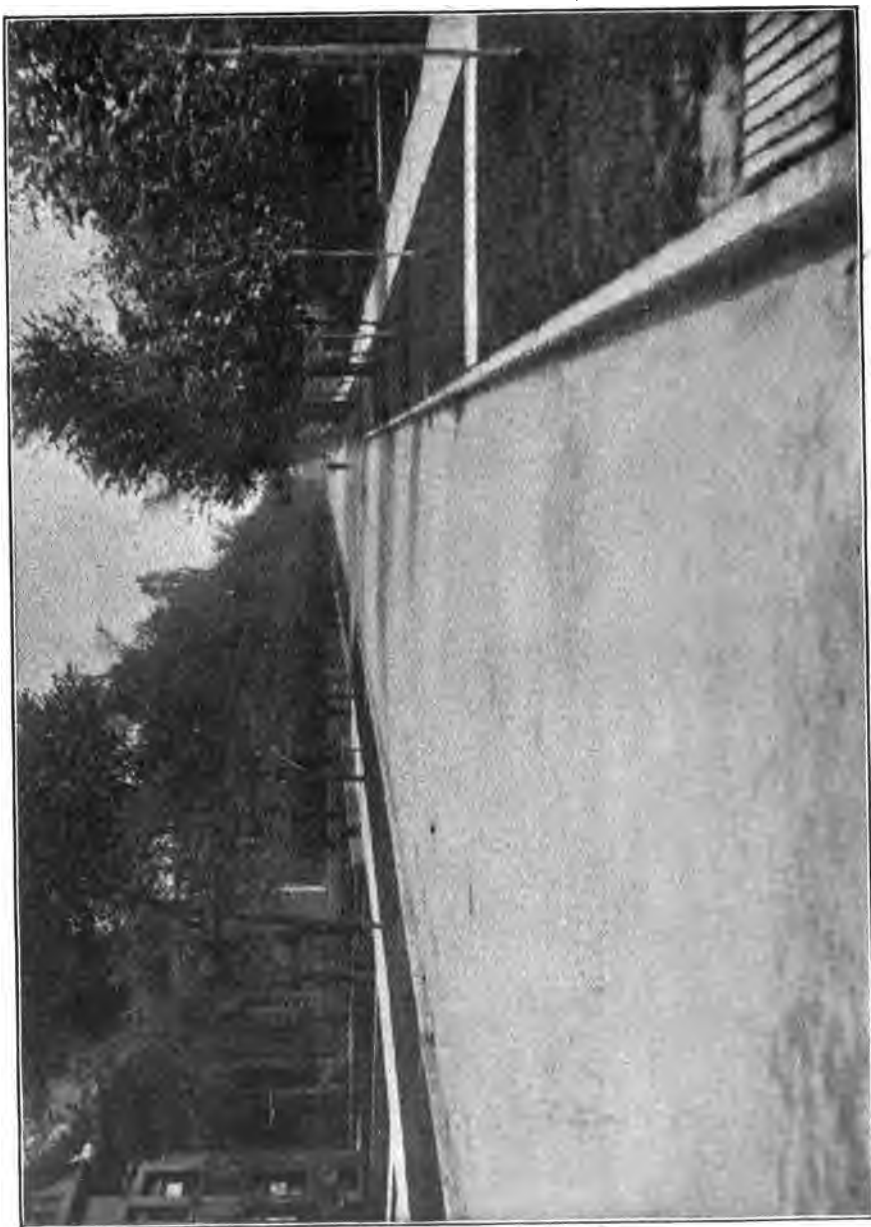
As Country Roads Should Be.



STEAM ROLLER.



AS COUNTRY ROADS SHOULD NOT BE.



ASPHALT.

